Subject Area Syllabus and Guidelines

Industrial Technology and Design Education

Level 4 to Beyond Level 6

Queensland Studies Authority

Partnership and innovation

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Industrial Technology and Design Education Subject Area Syllabus and Guidelines

Level 4 to Beyond Level 6

Cover pictures show students of Park Ridge State High School and The Gap State High School.

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Introduction

Subject area syllabuses have been developed to cater for specialised student interests within the framework of a core and common curriculum in Queensland.

The common curriculum and the subject areas

The role of the common curriculum for Queensland schools is to provide a comprehensive education for all students during the compulsory years of schooling. It consists of the eight nationally agreed key learning areas:

- The Arts
- English
- Health and Physical Education (HPE)
- Languages other than English (LOTE)
- Mathematics
- Science
- Studies of Society and Environment (SOSE)
- Technology.

The Queensland curriculum for the compulsory years of schooling is based on an outcomes approach.

The core of the Queensland curriculum for the compulsory years of schooling consists of a selection of essential learnings expressed as ‘core learning outcomes’. ‘Discretionary learning outcomes’ describe what students know and can do beyond what is essential at a particular level.

Key learning area syllabuses describe core learning outcomes in developmental levels along learning continua for the 10 years of compulsory schooling. The common curriculum is conceptualised as a whole, rather than segmented into sections for different phases of schooling.

During the later years of compulsory schooling, many schools may offer their students subjects that allow them to engage in specialised studies in specific contexts. Syllabuses have been developed for five subject areas that are typically a focus of curriculum choice and specialisation. These are:

- Agricultural Education
- Business Education
- Home Economics Education
- Industrial Technology and Design Education
- Information and Communication Technology Education.

Through the experiences, challenges and opportunities associated with each subject area, students develop a unique range of knowledge, practices and dispositions. These can be described through learning outcomes that are specific to the subject area. In certain contexts, some learning outcomes from different key learning areas contribute to a subject area.

Subject area syllabuses and guidelines

Syllabuses and guidelines have been developed for five subject areas. Typically, schools will use the subject area syllabuses to plan a variety of courses of study that will provide particular students with specialised learning experiences in specific contexts.

Subject area strands are contextual. The strands are used to organise the learning outcomes in the syllabus. The strands contain two types of learning outcomes — 'central learning outcomes' and 'supplementary learning outcomes'. The central learning outcomes describe the learnings that are considered fundamental to the subject area. It is recommended that these be the primary focus of a course of study developed for a subject area. Central learning outcomes consist of subject-area-specific learning outcomes and some core learning outcomes from different key learning areas. Supplementary learning outcomes are additional learning outcomes that could be considered for inclusion to enrich a course of study.

Central and supplementary learning outcomes have codes that identify the strand and developmental level to which they belong (see Outcomes section). If these learning outcomes have been selected from a key learning area syllabus, the key learning area code for that learning outcome is indicated in parentheses.

Subject area syllabuses describe learning outcomes from Level 4 to Beyond Level 6. Subject area syllabuses are not specifically associated with particular year levels of schooling; however, it is predicted that they will be used for planning courses of study in middle schools and lower secondary schools. These subject area syllabuses may also be used in other educational settings where there are specific student interests in the subject area, appropriate school resources and teacher expertise.

Subject area syllabuses cannot be regarded as alternatives to each other or to particular key learning areas. Each subject area syllabus contains different subsets of learning outcomes from different key learning areas, as well as learning outcomes that are specific to particular subject areas.

Courses of study

Courses of study are planned sets of learning experiences and assessment tasks that have a specified duration and location in a school's overall curriculum offering. They may be units offered within a vertical timetable, a semester, a single year or multiple years. Courses of study may be developed from any of the subject area and/or key learning area syllabuses.

The time allocation for courses of study based on subject area syllabuses is a school-based decision.

Subject area syllabuses enable schools to plan courses of study that meet a variety of student needs and interests.

When planning courses of study, the following should be considered:

- the needs of students
- resources and staff
- the place and role of courses of study within the total school curriculum.

Further information is available in the Guidelines section.

Rationale

Nature of the subject area

Industrial technology and design involves the design and manufacture of products, industrial systems and graphical representations. Industrial technology refers to the procedures and techniques used to organise and control systems, and combine and process materials into useful products. Industrial design focuses on the creation, development and communication of concepts and specifications for products.

The major industrial technology and design industries can be classified as manufacturing, construction and graphics. Each industry uses specific materials, resources and facilities, and specialised industrial practices. Industrial practice includes design and industry standards, workplace health and safety, resource management, and social, ethical and environmental responsibility.

Innovation and technological developments continually expand the range of materials, tools, equipment, processes and techniques that can be used in the development of industrial technology and design products.

The communication of design through sketches, annotations, documentation and graphical representations is an integral aspect of the design process. When communicating design ideas for different audiences, the needs of the audience influence the complexity and presentation of the communication.

People engage in industrial technology and design as personal, commercial or industrial activities to solve real-world problems, satisfy human needs and wants, and capitalise on opportunities. Informed and discriminating consumers evaluate the quality, characteristics and impacts of products. It is therefore important that quality designs and products are functional, aesthetically appealing and ergonomic.

Nature of learning in the subject area

Industrial Technology and Design Education provides the context for students to develop a unique repertoire of knowledge, practices and dispositions. Students also have opportunities to develop some knowledge, practices and dispositions from the key learning areas of Technology, The Arts, and Science in industrial technology and design contexts.

The subject area combines theoretical understandings with practical applications related to industrial systems and control, graphical communication, and product design and manufacture. Students design and create products using contemporary materials, tools, equipment, processes and techniques that are specific to industrial technology and design. Understandings of the appropriateness of products, as well as the social, ethical and environmental issues pertaining to material use, disposal and safety are included within the subject area. Industrial technology and design students work independently and collaboratively in activities that require them to meet constraints such as time, cost and availability of resources.

Through Industrial Technology and Design Education, students develop understandings of their made environment. They learn to be informed and responsible users of products and innovative developers of solutions to real-world problems. They are active participants in the development of industrial technology and design products.

Contribution of the subject area to lifelong learning

The Queensland school curriculum is designed to assist students to become lifelong learners. The overall learning outcomes of the curriculum contain elements common to all key learning areas and subject areas, and collectively describe the valued attributes of a lifelong learner.

A lifelong learner is:

- a knowledgeable person with deep understanding
- a complex thinker
- an active investigator
- a responsive creator
- an effective communicator
- a participant in an interdependent world
- a reflective and self-directed learner.

The Industrial Technology and Design Education subject area provides many opportunities for students to develop the valued attributes of lifelong learners.

Knowledgeable person with deep understanding

Learners understand that working in industrial technology and design often requires individuals to use knowledge from a range of fields and to challenge existing knowledge and practices. Learners:

- understand how specific products function, and workplace health and safety issues related to their development and use
- familiarise themselves with the nature of materials, industrial systems, graphical information, and product design and manufacture
- appropriately select and use tools, equipment, processes and techniques to manipulate materials to meet industrial technology and design challenges
- understand that industries use specific symbols, terminology and notational systems.

Complex thinker

Learners interpret, critically analyse and evaluate information when making decisions in industrial technology and design contexts. Learners:

- evaluate and manage potential risks and hazards associated with design and manufacture work sequences
- evaluate the suitability of materials and graphical information for particular purposes and audiences
- critically evaluate past and present technologies in terms of their social, ethical and environmental impacts
- critically evaluate the relevance, accuracy and validity of information.

Active investigator

Learners investigate and explore issues related to industrial technology and design challenges. Learners:

- investigate issues related to the use of traditional and contemporary technologies
- explore the impacts of the application of products on individuals, communities and environments
- evaluate the aesthetic, economic, environmental, functional, social, ethical and cultural implications of industrial products and designs
- investigate the suitability of materials, designs and manufacturing sequences through creating prototypes, models and simulations
- investigate cause-and-effect relationships within systems and use their findings to refine those systems.

Responsive creator

Learners develop solutions and use innovation and creativity to meet design challenges. Learners:

- generate and evaluate solutions to industrial technology and design challenges
- examine needs, wants and opportunities in relation to design challenges
- experiment with the tools, equipment, processes and techniques used to manipulate system components, graphical information and materials
- determine a variety of ways of developing safe and functional products
- propose alternative processes to streamline the design and manufacture of products.

Effective communicator

Learners interpret and communicate information, design ideas and proposals using appropriate language, symbols and representations. Learners:

- communicate the safe operation and maintenance requirements for new and modified products
- select appropriate genres to effectively communicate design ideas and production processes to particular audiences
- comprehend information presented in various forms, including 3D models, formal and informal drawings, photographs, multimedia images, diagrams, specifications, tables and graphs
- develop design proposals, design specifications, test reports, and product proposals and evaluations
- articulate social and ethical considerations related to the development and use of industrial technology and design
- apply relevant industry standards of industrial technology and design.

Participant in an interdependent world

Learners work cooperatively and use socially responsible behaviour as they work in industrial technology and design contexts. Learners:

- resolve conflict to achieve shared goals
- are aware of workplace health and safety implications in industrial and workshop environments

- work independently and collaboratively within a production environment
- challenge inequities and promote equitable practices.

Reflective and self-directed learner

Learners critically evaluate, reflect on assumptions and transfer learning strategies to everyday life. Learners:

- critically evaluate products and identify opportunities for improvements
- identify their strengths, limitations and preferred learning styles, and use this information to respond to personal and academic challenges
- predict possible obstacles and ways to overcome these within industrial technology and design challenges
- look for opportunities to use the knowledge, practices and dispositions associated with industrial technology and design in everyday life
- take action in relation to social and ethical issues associated with industrial technology and design.

Cross-curricular priorities

The Industrial Technology and Design Education subject area incorporates and promotes the cross-curricular priorities of literacy, numeracy, lifeskills and a futures perspective.

Literacy

Literacy is a social practice that uses language for thinking and making meaning in cultures. It includes reading and writing, speaking and listening, viewing and shaping, often in combination in multimodal texts within a range of contexts. Critical thinking is also involved in these practices. Students seek and critically appraise information, make choices and use their literacy skills to become independent learners. They develop critical literacy by questioning the cultural and social practices embedded in various kinds of texts. Students learn about relationships between the contexts and audiences of those texts. They understand that literacy influences how people view themselves, their identities and their environments as well as providing ways to represent these views.

Students interpret, critically evaluate and communicate technical information from a range of sources. They understand how graphical representations can be used to communicate with a range of audiences in different contexts. They use a variety of genres including design briefs, instructions, plans, flow charts, blueprints, pattern markings and diagrams to discover and exchange meaning. They use electronic and print media to locate, interpret and store information.

Numeracy

Numeracy is the demonstration of practices and dispositions that accurately, efficiently and appropriately meet the demands of typical everyday situations involving number, space, measurement and data.

Students develop and apply numeracy as they design and realise industrial products in response to real-life and lifelike challenges.

In Industrial Technology and Design Education, students develop numeracy through activities that include measuring, calculating, taking readings, applying formulae and costing. Design and problem-solving investigations involve meeting a range of numerical and spatial demands such as testing materials, estimating quantities, costing materials and presenting quotations. Data gathered through investigations may be translated into tables and graphs to enable analysis and comparison. The use of tools and equipment may require students to make calculations, determine ratios and proportions, and estimate production times. Industrial Technology and Design Education provides appropriate learning contexts and experiences for students to engage in, reflect on and develop competencies in numeracy.

Lifeskills

Lifeskills is a term used to describe the knowledge, practices and dispositions considered necessary for people to function adequately in their current and changing life roles and situations. Demonstration of lifeskills takes place in two overlapping dimensions: practical performance of, and critical reflection on, those skills.

It is possible to identify at least four sets of lifeskills that enable students to participate in four life roles. The lifeskills, and related life roles, are:

- personal development skills — growing and developing as an individual
- social skills — living with and relating to other people
- self-management skills — managing resources
- citizenship skills — receiving from and contributing to local, state, national and global communities.

Courses of study in Industrial Technology and Design Education contribute to the development of lifeskills by providing students with opportunities to participate in purposeful activities that prepare them for a variety of life roles.

Students develop confidence and self-esteem as they identify and develop expertise in the subject area and extend their personal interests. They recognise their personal strengths and weaknesses and those of others. Students appreciate the viewpoints, beliefs and values of others as they comprehend information, and develop and realise ideas and products.

Students work cooperatively and collaboratively with others and in teams. They develop and use interpersonal skills including conflict-resolution strategies. Students learn from real-life and lifelike situations and develop self-regulation, self-discipline and time-management skills. They develop strategies for creative thinking and problem solving.

Students develop their citizenship skills using a set of rights and responsibilities based on an understanding and valuing of cultural and linguistic diversity, and cultural practices of a diverse range of communities. They learn to make informed decisions as they build on their understandings of social justice and ethics.

Futures perspective

A futures perspective involves knowledge, practices and dispositions that enable students to identify individual and shared futures. A futures perspective leads to insights and understandings about thinking ahead, and the roles of individuals and groups in envisioning and enacting preferred futures.

Students with insights and knowledge about the past and present consider the consequences of past and future actions. They take responsibility for their actions and decisions and are empowered to participate optimistically in processes of social innovation, recovery and renewal.

Students develop a perspective of possible, probable and preferred futures that enables them to make informed and responsible decisions about the design, manufacture and use of products. Creating preferred futures requires practical applications of industrial technology and design to meet human needs and wants. Students develop understandings of the impacts and consequences of past, present and future industrial technology and design on individuals, local and global communities and their environments.

Other curricular considerations

The Industrial Technology and Design Education subject area also incorporates work education.

Work education

Work involves both the paid employment that people undertake and the unpaid work they perform within the groups, communities and societies to which they belong. It occurs with different types and groupings of people in different settings and is performed under many different conditions.

Work education involves **learning for work**, **learning about work** and **understanding the nature of work**:

- Learning for work involves developing work-related knowledge, practices and dispositions.
- Learning about work emphasises student understandings about work and the settings and conditions that characterise workplaces. It highlights the benefits of work to individuals and communities.
- Understanding the nature of work involves critically reflecting on and analysing the sociocultural, economic and political forces that influence the ways society values different kinds of work.

While work education includes providing opportunities for students to explore options for future education, training and paid employment, this is not its sole purpose; nor is it intended to focus exclusively on the development of vocationally oriented skills. Work education has a much broader role — that of preparing students for work in all the forms and contexts in which it occurs. This includes preparing students to participate effectively in paid and unpaid work, to understand the issues involved in balancing these different kinds of work (including family responsibilities), and to recognise the benefits to society of assisting workers to achieve this balance.

Students undertake investigations related to work in industrial technology and design contexts. They interact with and use technologies that are used in the workplace. Students examine the characteristics and behaviours required of workers in dynamic work environments and develop confidence to participate in challenging workplaces.

Students investigate work options in the industries of industrial technology and design. This enables them to plan and make choices about the more specific education, training and employment opportunities to be pursued in the immediate post-compulsory school years.

Students understand the changing nature of paid and unpaid work and different work arrangements such as full-time, part-time, voluntary and casual work. They develop understandings of the workplace, work cultures and the labour market. Students consider the future of education, training and work, and reflect on work practices and management.

Students appreciate the role of and value participation in community activities and projects involving industrial technology and design for individuals, communities and societies.

Understandings about learners and learning

The following assumptions about learners and learning underpin the Industrial Technology and Design Education subject area.

Learners

- Learners are unique individuals and thinkers with divergent views about the world.
- Learners have a broad range of knowledge, attitudes, values and experiences shaped by their gender, socioeconomic status and geographical location, and by other aspects of their background, all of which form part of their learning environment. Their prior knowledge and experiences influence the meaning they make of any new learning experience.
- Learners grow, develop and learn in different ways, in different settings and at different rates. By engaging in learning activities that match their needs, interests, understandings and individual learning styles, learners have opportunities to develop and extend their capabilities.

Learning

- Learning is a lifelong process.
- Learning occurs within and across cultural contexts and social situations and is influenced by them.
- Learning is most effective when the learning environment is safe, supportive, enjoyable, collaborative, challenging and empowering.
- Learning is most effective when it involves active partnerships with students, parents/carers, peers, teachers, and school and community members.
- Learning contexts should acknowledge equity principles by being inclusive and supportive and by acknowledging and valuing diversity.
- Learning is enhanced and supported when teaching approaches are culturally sensitive.
- Learner-centred strategies are most effective in enabling learners to make informed choices and to take actions that support their own and others' wellbeing.
- Learning requires active construction of meaning and is effective when it is developed in meaningful contexts and accommodates, acknowledges and builds on prior knowledge.
- Learning is enhanced when learners have opportunities to reflect on their own thinking and learning.
- Learning is enhanced by the use of a range of technologies.

Learner-centred approach

A learner-centred approach to learning and teaching views learning as the active construction of meaning, and teaching as the act of guiding and facilitating learning. This approach considers knowledge as being ever-changing and built on prior experience.

A learner-centred approach provides opportunities for students to practise critical and creative thinking, problem solving and decision making. This involves recall, application, analysis, synthesis, prediction and evaluation, all of which contribute to the development and enhancement of conceptual understandings. A learner-centred approach also encourages students to reflect on and monitor their thinking as they make decisions and take action.

Industrial Technology and Design Education provides opportunities for students to participate in practical and innovative problem-solving activities within a range of industrial technology and design contexts. They make decisions about what they learn and how they learn in partnership with peers, teachers and people from the industry. Students learn by exploring, experimenting, researching and evaluating in the contexts of the made world.

Equity in the curriculum

The Queensland school curriculum is designed to challenge inequities by:

- acknowledging and minimising unequal outcomes of schooling for different groups of students
- identifying and minimising barriers to access, participation, active engagement, construction of knowledge and demonstrations of learning
- using the knowledge, practices and dispositions of all students as a basis for their learning and for enhancing the learning of others in the community
- developing understanding of, and respect for, diversity within and among groups
- making explicit the fact that knowledge is historically, socially and culturally constructed
- making explicit the relationship between valued knowledge and power relations
- identifying and promoting the capacity of the Industrial Technology and Design Education subject area to develop knowledge, practices and dispositions that empower students to challenge injustices and inequities.

The curriculum also provides opportunities for students to learn about equity and equity issues in the context of the subject area.

Student access and participation

In an inclusive curriculum, consideration is given to the interrelationships between culture, language, ability, gender, sexual identity, location and socioeconomic circumstance, and their impact on students' perspectives and experiences, and therefore access to, and success in, the curriculum.

Students bring varied prior experiences to the classroom, some of which support their learning in Industrial Technology and Design Education, and others that may make this more difficult for them. Students' diverse experiences and their resultant perspectives of industrial technology and design need to be considered when planning.

The selection of concepts, contexts, contents and learning experiences needs to accommodate the diverse learning styles, interests and experiences of students if learning is to be maximised.

Learning about equity

Students explore, express and challenge personal, group and societal values that reinforce and perpetuate inequities.

Through the learning activities in Industrial Technology and Design Education, students understand and appreciate diverse needs and perspectives, and learn to value and respect people, cultures and their environments. Students develop knowledge, practices and dispositions to critique social and political structures and power relations created through industrial technology and design activities that have the potential to work for or against individuals or groups.

Students develop understandings about the historical, societal, cultural, spiritual, political and economic constructions of and contexts in which industrial technology and design products and practices are created and valued, and the dynamic interrelationships that exist between these. This promotes understanding of the heterogeneity of practices, beliefs and values within and across cultural groups. This, in turn, empowers students to become lifelong learners and active and critical participants in interdependent societies.

Outcomes

Framework

This syllabus provides a framework for planning learning activities and assessment opportunities through which students demonstrate what they know, and can do with what they know, in the Industrial Technology and Design Education subject area.

Subject area outcomes

The subject area outcomes highlight the uniqueness of the Industrial Technology and Design Education subject area and its particular contribution to lifelong learning. In this subject area, students develop the knowledge, practices and dispositions necessary to:

- meet industrial technology and design challenges in response to needs and wants and to capitalise on opportunities
- create, modify and maintain industrial systems
- use graphical construction and presentation techniques to effectively communicate design ideas and procedures to others
- select and manipulate a range of industrial materials to meet industrial technology and design challenges
- understand the nature of industrial and design standards
- identify workplace health and safety hazards in workshop and industrial environments and manage associated risks in their own work environments
- organise and manage time, materials and production resources into logical and structured sequences of operations
- make informed and discriminating choices as consumers of industrial technology and design products
- reflect on and evaluate relationships between industrial technology and design, and the development of societies
- appreciate that different societies have developed and used different technologies according to their needs, wants and opportunities, knowledge, available resources, environments and cultural values, and will continue to do so in the future.

Strands of the subject area

The learning outcomes of the Industrial Technology and Design Education subject area are organised into three strands:

- Industrial Systems and Control
- Graphical Communication
- Product Design and Manufacture.

Students develop their understandings of the concepts within the strands throughout the later years of compulsory schooling. Courses of study can be planned using learning outcomes from a single strand or from a number of strands.

Industrial Systems and Control

This strand focuses on ways of organising components of industrial systems and their subsystems to achieve a specific goal. Components of industrial systems may or may not contain a human element as part of the system.

Students investigate the structures and functions of industrial systems by using, dismantling, analysing, modifying, maintaining and creating industrial systems. They understand components and energy sources and their relationships within industrial systems. Students work with different types of systems such as mechanical (levers, cams, gears, springs), electrical (switches, motors, lights), electronic (sensors, solar), pneumatic (jack, brakes) and computer control (CNC lathe, engine management). They investigate the development of industrial systems and evaluate the past, present and future impacts of industrial systems on societies and environments.

The organisers for this strand are:

- development of industrial systems
- nature of industrial systems
- techniques for manipulating industrial systems
- technology practice.

Graphical Communication

This strand focuses on the nature of graphical communication and the coding systems and genres used in graphical representations. Students convey meaning to others when they create graphical representations that use the elements and principles of design, and graphical construction and presentation techniques. The way students use the elements and principles of design determines how effectively a message is communicated to an intended audience. Students develop solutions to graphical communication design challenges for a range of audiences using a range of media. They develop visual literacy as they view, read, comprehend and generate graphical representations and consider what can be seen and how people interpret what is seen.

The organisers for this strand are:

- elements and principles of design
- graphical communication design
- nature of graphical information
- techniques for manipulating graphical information.

Product Design and Manufacture

This strand focuses on the design and manufacture of products. Students create products that meet human needs and wants, and capitalise on opportunities. Understandings of the characteristics of materials are used to select and manipulate materials to meet design challenges. Students identify potential hazards and risks in workshop and industrial environments and demonstrate safe practices in their own work environment.

The organisers for this strand are:

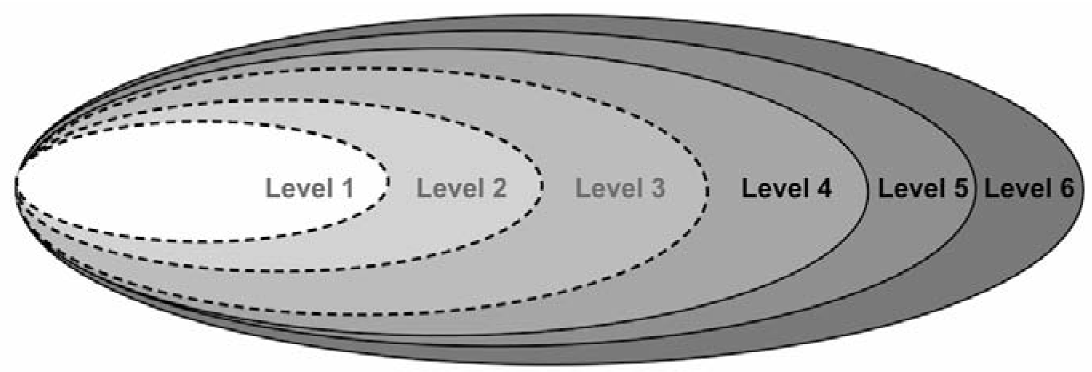
- safety in workshop and industrial environments

- nature of industrial materials
- techniques for manipulating industrial materials
- technology practice.

Levels

The levels outlined on the following pages indicate progressions of increasing sophistication and complexity in learning outcomes. This syllabus describes learning outcomes for Level 4, Level 5, Level 6 and Beyond Level 6. The sequencing of the learning outcomes is such that each level is 'nested' within the following level. Learning outcomes for successive levels are conceptually related to each other, forming a continuum rather than existing simply as a number of discrete entities.

A level statement is included for each level of each strand of the syllabus. The level statement summarises learning outcomes at each level and provides a framework for developing the central and supplementary learning outcomes.



Progression of conceptual development of outcomes

Central learning outcomes

Central learning outcomes describe those learnings that are considered fundamental to a course of study based on a subject area syllabus. They describe what students know, and can do with what they know, as a result of planned learning activities. The central learning outcomes are presented in order of increasing complexity from Level 4 to Beyond Level 6. Students should be provided with multiple opportunities to demonstrate those learning outcomes selected for inclusion in a course of study. A course of study may include only some of the learning outcomes described in this syllabus.

Central learning outcomes may be of two types:

- subject-area-specific learning outcomes — these are specific to the subject area and are not described in the core learning outcomes of the key learning areas
- core learning outcomes — these are selected from antecedent key learning areas, in a subject area context, and are fundamental to the subject area. Core learning outcomes are included from the Technology key learning area. These learning outcomes are labelled to indicate their key learning area code and strand codes. For example, a core learning outcome from the *Years 1 to 10 Technology Syllabus* and Technology Practice strand will be coded as Tech TP.

Supplementary learning outcomes

Supplementary learning outcomes describe what students know, and can do with what they know, beyond what is considered fundamental at a particular level. They indicate additional learnings considered desirable. The supplementary learning outcomes are included to assist teachers in broadening the understandings of those students who have already demonstrated central learning outcomes. Additional supplementary learning outcomes could be developed by schools or teachers. At Beyond Level 6 all learning outcomes are supplementary.

Relationship of outcome levels to year levels

For the purposes of planning learning activities and assessment opportunities, outcome levels typically relate to years of schooling as follows:

- students demonstrating Level 4 outcomes are at the end of Year 7
- students demonstrating Level 6 outcomes are at the end of Year 10.

Some students will demonstrate learning beyond the typical levels described above. Other students will require more time to demonstrate their learning.

*L*earning outcomes

Industrial Systems and Control

Organisers for the learning outcomes in the Industrial Systems and Control strand are:

- development of industrial systems
- nature of industrial systems
- techniques for manipulating industrial systems
- technology practice.

Level 4	Level 5
Level statement	**Level statement**
Students investigate the use of systems and control within industrial technology and design industries. They understand the logic of systems and subsystems. They refine, modify and create industrial systems. They use technology practice to develop industrial systems.	*Students investigate the influences on the development of current industrial systems. They understand the structure, controls and management of systems and incorporate these in systems and subsystems. They use technology practice to develop industrial systems.*
Central learning outcomes	**Central learning outcomes**
ISC 4.1 Students investigate the systems and subsystems used within industrial technology and design industries.	**ISC 5.1** Students investigate the influences that have led to the development of industrial systems.
ISC 4.2 Students identify and explain the logic of systems and subsystems. (Tech SYS 4.1)	**ISC 5.2** Students explain structures, controls and management of systems and subsystems. (Tech SYS 5.1)
ISC 4.3 Students incorporate feedback to refine and modify systems and/or subsystems. (Tech SYS 4.2)	**ISC 5.3** Students incorporate control and management mechanisms in systems that include subsystems. (Tech SYS 5.2)
ISC 4.4 Students use technology practice (as described in the Level 4 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to develop industrial systems (see appendix 1).	**ISC 5.4** Students use technology practice (as described in the Level 5 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to develop industrial systems (see appendix 1).
Supplementary learning outcome	**Supplementary learning outcome**
ISC 4.5 Students explain different energy sources and can identify their use in simple systems.	**ISC 5.5** Students discuss the consequences of different ways of obtaining and using energy (including nuclear energy). (Sc EC 5.3)

Key:

- Sc — in *Years 1 to 10 Science Syllabus*; Strand: EC — Energy and Change.
- Tech — in *Years 1 to 10 Technology Syllabus*; Strand: SYS — Systems.

Learning outcomes

Industrial Systems and Control

Organisers for the learning outcomes in the Industrial Systems and Control strand are:

- development of industrial systems
- nature of industrial systems
- techniques for manipulating industrial systems
- technology practice.

Level 6	Beyond Level 6
Level statement	**Level statement**
Students analyse and predict the impacts of trends related to the creation and development of industrial systems. They explain principles of complex systems, and devise ways to manage and monitor the operation of these systems. They use technology practice to develop industrial systems.	*Students prepare scenarios about the possible, probable and preferred futures for industrial systems. They identify relationships within systems and use specialised techniques to optimise their impacts. They use technology practice to develop industrial systems. They use technology practice to develop industrial systems.*
Central learning outcomes	**Supplementary learning outcomes**
ISC 6.1 Students analyse trends in the development of industrial systems and describe how these might impact upon local industries.	**ISC B6.1** Students prepare scenarios about possible, probable and preferred futures related to industrial systems and describe their environmental, social and economic impacts.
ISC 6.2 Students explain principles underlying complex systems in terms of structures, control and management. (Tech SYS 6.1)	**ISC B6.2** Students identify internal and external relationships of systems in order to optimise and enhance beneficial impacts. (Tech SYS B6.1)
ISC 6.3 Students devise ways to manage and monitor the operation of complex systems. (Tech SYS 6.2)	**ISC B6.3** Students develop and optimise complex systems and subsystems by selecting and using specialised techniques. (Tech SYS B6.2)
ISC 6.4 Students use technology practice (as described in the Level 6 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to develop industrial systems (see appendix 1).	**ISC B6.4** Students use technology practice (as described in the Beyond Level 6 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to develop industrial systems (see appendix 1).
Supplementary learning outcomes	
ISC 6.5 Students evaluate the immediate and long-term consequences of different ways of obtaining and using energy. (Sc EC 6.3)	**ISC B6.5** Students critically analyse global patterns of energy use and make predictions about the effects of such use. (Sc ECD B6.3)
ISC 6.6 Students model and analyse applications of energy transfer and transformation. (Sc EC 6.2)	

Key:

- Sc — in *Years 1 to 10 Science Syllabus*; Strand: EC — Energy and Change.
- Tech — in *Years 1 to 10 Technology Syllabus*; Strand: SYS — Systems.

Learning outcomes

Graphical Communication

Organisers for the learning outcomes in the Graphical Communication strand are:

- elements and principles of design
- graphical communication design
- nature of graphical information
- techniques for manipulating graphical information.

Level 4	Level 5
Level statement *Students investigate the use of the elements and principles of design in graphical representations. They analyse the forms and sources of graphical information. They use accepted construction and presentation techniques to transform and transmit information, and present solutions to design challenges for different audiences.*	**Level statement** *Students use the elements and principles of design to respond to design challenges. They select appropriate techniques to manipulate space, and use them to manage and present information for specific users. They explain how design and production decisions are influenced by the changes in the nature of graphical information.*
Central learning outcomes	**Central learning outcomes**
GC 4.1 Students investigate the use of the elements and principles of design in graphical representations.	**GC 5.1** Students use the elements and principles of design to produce graphical representations for design challenges.
GC 4.2 Students use simple construction techniques to present graphical responses to design challenges.	**GC 5.2** Students select construction techniques to manipulate simple figures in graphical responses to design challenges.
GC 4.3 Students analyse sources and forms of information and match these to the requirements of design challenges. (Tech INF 4.1)	**GC 5.3** Students explain how changes to sources, forms and management of information affect design and production decisions. (Tech INF 5.1)
GC 4.4 Students apply techniques for transforming and transmitting information for different audiences. (Tech INF 4.2)	**GC 5.4** Students compare and select techniques for processing, managing and presenting information for specific users. (Tech INF 5.2)
Supplementary learning outcome	**Supplementary learning outcomes**
GC 4.5 Students deconstruct and reconstruct images and objects to manipulate meaning through explorations of elements and additional concepts. (Arts VA 4.1)	**GC 5.5** Students make images and objects to express personal responses to researched ideas. (Arts VA 5.1a) **GC 5.6** Students research and experiment with ideas to document sensory responses to developmental processes in making. (Arts VA 5.1b)

Key:

- Arts — in *Years 1 to 10 The Arts Syllabus*; Strand: VA — Visual Arts.
- Tech — in *Years 1 to 10 Technology Syllabus*; Strand: INF — Information.

*L*earning outcomes

Graphical Communication

Organisers for the learning outcomes in the Graphical Communication strand are:

- elements and principles of design
- graphical communication design
- nature of graphical information
- techniques for manipulating graphical information.

Level 6	Beyond Level 6
Level statement	**Level statement**
Students determine the use of elements and the organisation of space in graphical representations. They select specialised techniques to manage and organise the presentation of graphical information, and model and design solutions to challenges. They analyse how the ownership and control of graphical information influences various societies.	*Students analyse the use of elements and principles of design and space in commercial designs. They use construction and presentation techniques that reflect innovation and industry needs to present graphical information. They describe how to capitalise on changes in the ways societies use information.*
Central learning outcomes	**Supplementary learning outcomes**
GC 6.1 Students justify the use of the elements and principles of design when producing graphical representations in response to a design challenge.	**GC B6.1** Students present responses to design challenges that reflect a critical analysis of the ways the elements and principles of design are used in commercial graphics.
GC 6.2 Students select construction techniques to combine figures and objects in response to design challenges.	**GC B6.2** Students combine and modify construction and presentation techniques that emphasise key features and satisfy specific industry needs.
GC 6.3 Students analyse issues related to the ownership and control of information in societies. (Tech INF 6.1)	**GC B6.3** Students identify changes in the ways information is presented and used in societies and describe how to capitalise on these changes to meet the needs of specific communities and groups. (Tech INF B6.1)
GC 6.4 Students use specialised techniques for managing and organising the presentation of information to meet detailed specifications. (Tech INF 6.2)	**GC B6.4** Students develop and use specialised techniques to present information in innovative ways. (Tech INF B6.2)
Supplementary learning outcome	
GC 6.5 Students make images and objects to interpret chosen social and cultural issues. (Arts VA 6.1a)	**GC B6.5** Students make images and objects to research, develop and resolve a personal theme or idea. (Arts DVA 6.1)

Key:

- Arts — in *Years 1 to 10 The Arts Syllabus*; Strands: DVA — Discretionary Visual Arts; VA — Visual Arts.
- Tech — in *Years 1 to 10 Technology Syllabus*; Strand: INF — Information.

*L*earning outcomes

Product Design and Manufacture

Organisers for the learning outcomes in the Product Design and Manufacture strand are:

- safety in workshop and industrial environments
- nature of industrial materials
- techniques for manipulating industrial materials
- technology practice.

Level 4	Level 5
Level statement *Students demonstrate safe work practices. They explain how materials are manipulated in different ways depending on their characteristics. They employ the assistance of others in using equipment and techniques to manipulate materials. They use technology practice to design and manufacture products.*	**Level statement** *Students identify hazards and use risk-control strategies in their work environments. They compare materials to determine their effectiveness in meeting predetermined standards. They use equipment and techniques to meet predetermined standards. They use technology practice to design and manufacture products.*
Central learning outcomes	**Central learning outcomes**
PDM 4.1 Students demonstrate safe practices in workshop environments.	**PDM 5.1** Students identify potential hazards and demonstrate risk-control measures to manage safe work practices.
PDM 4.2 Students explain how characteristics of materials affect ways they can be manipulated. (Tech MAT 4.1)	**PDM 5.2** Students compare and contrast materials according to their characteristics to determine how effectively the materials meet predetermined standards. (Tech MAT 5.1)
PDM 4.3 Students employ their own and others' practical knowledge about equipment and techniques for manipulating and processing materials in order to enhance their products. (Tech MAT 4.2)	**PDM 5.3** Students operate equipment and apply techniques for manipulating and processing materials to meet predetermined standards. (Tech MAT 5.2)
PDM 4.4 Students use technology practice (as described in the Level 4 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to design and manufacture products (see appendix 1).	**PDM 5.4** Students use technology practice (as described in the Level 5 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to design and manufacture products (see appendix 1).
Supplementary learning outcome	**Supplementary learning outcome**
PDM 4.5 Students examine and assess ways that materials can be changed to make them more useful. (Sc NPM 4.3)	**PDM 5.5** Students devise tests and interpret data to show that the properties and interactions of materials influence their use. (Sc NPM 5.3)

Key:

- Sc — in *Years 1 to 10 Science Syllabus*; Strand: NPM — Natural and Processed Materials.
- Tech — in *Years 1 to 10 Technology Syllabus*; Strand: MAT — Materials.

*L*earning outcomes

Product Design and Manufacture

Organisers for the learning outcomes in the Product Design and Manufacture strand are:

- safety in workshop and industrial environments
- nature of industrial materials
- techniques for manipulating industrial materials
- technology practice.

Level 6	Beyond Level 6
Level statement *Students devise and implement strategies to manage risks in workshop environments. They consider the impacts of material selection and use, and incorporate these considerations into their design proposals. They use specialised equipment and techniques to manipulate materials to meet detailed specifications. They use technology practice to design and manufacture products.*	**Level statement** *Students propose management strategies to enhance safety in industrial work environments. They challenge traditional uses of materials and use a range of equipment and techniques to approximate commercial and industrial standards. They use technology practice to design and manufacture products.*
Central learning outcomes	**Supplementary learning outcomes**
PDM 6.1 Students develop and implement strategies and control measures to manage risks in workshop environments.	**PDM B6.1** Students investigate hazards in industrial environments and propose management strategies.
PDM 6.2 Students incorporate in their design proposals ideas about the impacts of particular materials used in products. (Tech MAT 6.1)	**PDM B6.2** Students challenge traditional uses of materials by applying their understandings about the characteristics of materials in the creation of innovative products. (Tech MAT B6.1)
PDM 6.3 Students use specialised equipment and refined techniques to make quality products to detailed specifications. (Tech MAT 6.2)	**PDM B6.3** Students use a variety of equipment and techniques to approximate commercial or industrial standards when combining or modifying materials. (Tech MAT B6.2)
PDM 6.4 Students use technology practice (as described in the Level 6 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to design and manufacture products (see appendix 1).	**PDM B6.4** Students use technology practice (as described in the Beyond Level 6 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to design and manufacture products (see appendix 1).
Supplementary learning outcome	
PDM 6.5 Students collect and present information about the relationship between the commercial production of industrial, agricultural and fuel products and their properties. (Sc NPM 6.3)	**PDM B6.5** Students design qualitative and quantitative investigations to compare natural and alternative synthetic materials. (Sc NPM DB6.3)

Key:

- Sc — in *Years 1 to 10 Science Syllabus*; Strand: NPM — Natural and Processed Materials.
- Tech — in *Years 1 to 10 Technology Syllabus*; Strand: MAT — Materials.

Using learning outcomes to plan for learning and assessment

Learning outcomes provide a framework for planning learning and assessment by describing what it is that students should know and be able to do with what they know. Using learning outcomes for planning involves:

- adopting a learner-centred approach to learning and teaching
- planning learning activities and assessment at the same time
- assisting students to work towards demonstrating their learning
- establishing clear expectations of student demonstrations as a basis for monitoring the progress of student learning.

The learning outcomes are sequenced conceptually in four progressive levels. This conceptual development is represented in the level statements for each strand. Learning outcomes at each level are qualitatively different from the corresponding learning outcomes at the levels before and after. This sequencing across levels helps teachers plan learning activities to cater for the range of developmental characteristics of students.

When planning units of work, teachers could select learning outcomes from within a strand, across strands, across levels or across subject areas and key learning areas. Assessment tasks provide opportunities for students to demonstrate their learning.

Planning should make provision for students to demonstrate learning in more than one context and on more than one occasion. Activities incorporating a variety of content and contexts should be organised to provide these opportunities. Planning for learning and planning for assessment are concurrent processes. Learning activities can be opportunities for teachers to gather evidence about students' demonstrations of learning.

Central content

The central learning outcomes and central content are the focus for planning learning activities and assessment tasks.

The organisation of content within a strand should not be considered hierarchical. Any of the content can be considered at any level; not all of the content need be selected at every level. Central content should be selected to suit students' needs, interests and abilities and to take account of their prior knowledge and experiences.

The central content of each strand is identified on the following pages.

Central content

Industrial Systems and Control

Development of industrial systems

- industrial systems and subsystems
  - hydraulic, pneumatic, mechanical, electrical, electronic, chemical, logic
- trends in the development of industrial systems
- factors influencing the development of industrial systems
  - operating environment
  - commercialisation and enterprise
  - functional and economic requirements
  - need to improve effectiveness and efficiency
  - workplace health and safety issues
  - past, present and future perspectives of industrial technology
  - industrial and control standards and conventions
- impacts of industrial systems on the environment, industries, economies, individuals and communities.

Nature of industrial systems

- role of components in systems
- inputs, processes and outputs
- relationship between components of systems and control elements
- energy sources used as inputs in industrial systems
- reliability.

Techniques for manipulating industrial systems

- techniques used in developing and maintaining industrial systems
  - assembling and dismantling, testing and trialling, monitoring and diagnosing, programming, managing and controlling, modifying and refining
  - safe and efficient control and use of energy sources
- tools and equipment
  - selection, safe use, storage and maintenance.

Technology practice*

- investigation
- ideation
- production
- evaluation
- impacts and consequences.

* Refer to appendix 2 for core content of Technology Practice.

Central content

Graphical Communication

Elements and principles of design

- elements of design — points, lines, shapes, colours, textures, sizes, tones
- principles of design — balance, harmony, contrast, repetition, proportion, variety, emphasis
- how the selection, use and presentation of the elements and principles of design influences the communication of graphical information.

Graphical communication design

- design requirements
  - purpose of the communication (sales, manufacture, advertising, reporting, instructional, informative, explanatory)
  - audience needs
  - functional and economic requirements
- communication of design concepts (requirements, ideas, concepts, specifications, solutions, refinements, amendments, evaluations)
- commercialisation and enterprise.

Nature of graphical information

- global trends in the use of graphical communication
- impacts of graphical communication on society
- sources and forms of information.

Techniques for manipulating graphical information

- factors influencing the selection of techniques
  - form/shape
  - single, component and composite surfaces
  - use of design elements to emphasise different features of a presentation
- constructing, modifying, intersecting, projecting, transferring, rotating, presenting, arranging, sequencing, modelling, analysing, transforming and critiquing graphics
- generating, sharing, recording and storing graphical information
- projecting, constructing and sectioning
- lettering and presenting
- scaling
- media platforms
  - selection, safe use, storage and maintenance of equipment
- graphical communication technologies
  - computers, drawing boards, drafting machines, plotters and printers
  - past, present and future graphical communication technologies
- standards (AS1100) and conventions for graphical communication.

Central content

Product Design and Manufacture

Safety in workshop and industrial environments

- potential health and safety issues in workshops and industrial work environments
  - risks and hazards
- safe work practices — strategies to manage and control risks and hazards
  - identifying and minimising potential hazards and risks
  - safe work procedures and sequences
  - safe disposal of waste
  - selection and safe use of energy sources
- occupational workplace health and safety policies and procedures.

Nature of industrial materials

- current trends in material development and use
  - range of current industrial materials
  - potential uses of current materials
- characteristics of materials
  - natural and synthetic materials
  - chemical and physical characteristics of materials
  - relationship of characteristics to performance
  - testing of materials to determine characteristics
- suitability of materials for specific purposes
  - design requirements
  - influences on material selection — function, form/shape, economics, complexity of construction
  - impacts and consequences of materials used.

Techniques for manipulating industrial materials

- techniques for manipulating and processing materials
  - forming, separating, combining, conditioning, finishing
- production standards
- value of machine-generated and handcrafted products.

Technology practice*

- investigation
- ideation
- production
- evaluation
- impacts and consequences.

* Refer to appendix 2 for core content of Technology Practice.

Assessment

Assessment is the purposeful, systematic and ongoing collection of evidence for use in making judgments about students' learning. In this syllabus, the central learning outcomes are presented in levels of increasing sophistication and complexity to form continua of learning. The assessment focuses on monitoring demonstrations of learning to provide evidence of student progress in this subject area.

Purposes of assessment

Information obtained from assessment can be used for a variety of purposes, including providing feedback on students' learning and informing decision making about students' progress.

Providing feedback

Assessment:

- provides ongoing feedback on the progress of individual students and groups of students throughout the learning and teaching process
- informs students, teachers, parents/carers, others in the community and/or school authorities about students' learning.

Informing decision making

Assessment information helps teachers to:

- make decisions about student needs, the learning and teaching process, and resource requirements
- plan learning and teaching programs for individuals, classes and the whole school
- discuss future learning pathways with students and parents/carers
- make decisions about providing learning support to particular groups of students
- develop learning resources and curriculum materials.

Principles of assessment

For assessment to be effective, it should:

- focus on learning
- be comprehensive
- be valid and reliable
- take account of individual learners
- be an integral part of the learning and teaching process
- provide opportunities for students to take responsibility for their own learning and for monitoring their own progress
- reflect equity principles.

Focus on learning

Assessment should focus on what students are expected to know and be able to do with what they know. Students should be made aware of what is being assessed, how and when they will be assessed, and how judgments will be made about their demonstrations of learning. Teachers may then use information from assessment to plan further learning.

Comprehensive range of evidence

Judgments about students' demonstrations of learning should be based on a comprehensive range of evidence gathered and recorded over time. To collect such evidence, teachers need to provide multiple opportunities in a variety of contexts for students to demonstrate what they know and can do with what they know, and use a variety of assessment techniques and recording instruments. Because students have different learning styles, evidence should be gathered from various sources. (Examples of assessment techniques, recording instruments and sources are provided in table 1 on page 30.)

Valid and reliable evidence

Assessment should provide valid and reliable evidence. It is essential that judgments about what students know and can do with what they know are based on a broad range of evidence gathered and recorded over time. Teachers' judgments should be consistent within their own classes for different students, for different assessment opportunities, and at different times. They should also be consistent with the judgments of other teachers in their own school and other schools.

Individual learners

At any one time in their schooling, students could demonstrate their learning in different ways and at different levels. When planning assessment, teachers need to take account of the fact that each student will progress at a different rate across and within the subject area. They also need to take account of factors that influence students' learning — in particular, their prior knowledge, experiences and unique circumstances, and their social, emotional, physical, cognitive and linguistic development.

Integral part of learning and teaching process

Assessment is an integral part of the learning and teaching process and should support students' learning. As teachers plan learning activities, they should also plan how they will monitor student progress. Learning activities can be used as opportunities to gather evidence about the progress of students' learning. Assessment opportunities should match the learning activities and teaching methods students have experienced. Assessment opportunities should be meaningful, interesting and challenging, and contribute to the development of students as lifelong learners.

Responsibility for own learning and self-monitoring

Assessment should provide feedback and help students take responsibility for their own learning. This involves giving students opportunities to set their own learning goals, to monitor their progress in relation to their learning, and to gather information that they and others can use to make decisions about future learning. Opportunities also need to be provided for students and teachers to develop shared understandings about how learning might be demonstrated, and for students to explain in their own terms how they might demonstrate their learning.

Equity principles

Assessment based on principles of equity enables students to demonstrate learning in ways that are sensitive to, and inclusive of, their circumstances. When planning and conducting assessment, teachers need to take account of students' learning styles, abilities, disabilities, gender, sexual identity, socioeconomic circumstances, cultural and linguistic backgrounds, and geographical locations. This includes:

- providing assessment opportunities that assist students, or groups of students, to overcome barriers that might limit their demonstrations of what they know and can do with what they know
- negotiating assessment with students so that they maximise their opportunities to demonstrate their learning.

Process of assessment

The process of assessment involves:

- providing students with opportunities to demonstrate what they know and can do with what they know
- gathering and recording evidence of students' learning
- using the evidence to make overall judgments about students' learning.

Opportunities to demonstrate learning

Students should have multiple opportunities to demonstrate the learning that has been the focus of planned activities. Assessment opportunities need to be provided over time and in a range of contexts. Teachers can use learning activities as assessment opportunities, or design specific tasks that provide students with opportunities to demonstrate their learning.

Gathering and recording evidence

Evidence about students' learning should come from several different sources and be gathered and recorded over time using a variety of assessment techniques and recording instruments. This evidence should be relevant to the learning being assessed and should be collected in a focused and systematic way.

Sources of evidence

Using evidence from a variety of sources accommodates different learning styles, the different ways in which students may demonstrate learning, and learning that has taken place in different contexts. Sources of evidence can include learning activities as well as specifically designed assessment tasks. Examples of activities, tasks, products or processes that could be used as sources of evidence are shown in table 1.

Assessment techniques

Assessment techniques include observation, consultation and focused analysis. Peer- and self-assessment can also be used to gather evidence about students' learning. Combinations of these techniques provide teachers with more comprehensive evidence on which to base judgments.

Assessment techniques should be selected to suit the context in which the learning is being demonstrated, and the type of evidence required. Teachers should familiarise students with the techniques through modelling and practice. Descriptions of these techniques are provided in table 1.

Record keeping

Record keeping must support planning and be manageable and easily maintained. It must also provide accurate evidence drawn from a range of contexts.

Teachers need to keep records on observation, consultation, focused analysis and peer- and self-assessment. Several examples of recording instruments are listed in table 1.

A **student folio** is a useful way of collating and storing evidence about a student's learning. Folios are developed over time and can include evidence such as responses to assessment tasks, products from learning activities, annotated samples of work, anecdotal records, checklists, photographs or video/audio tapes. This collection of work provides an informative picture of a student's accomplishments. Materials for the folio could be selected by the student or the teacher, or by negotiation between the two.

The use of the folio will determine which materials are included. Examples of folios include working folios for ongoing feedback, documentary folios for making judgments, and show folios for reporting and comparing judgments.

Table 1: Examples of ways to gather and record evidence from a variety of sources

Sources of evidence	Assessment techniques	Recording instruments
Students can provide evidence about what they know, and can do with what they know, in a variety of forms. These include: • practical tasks such as product development and construction, models and prototypes, trade displays • oral tasks such as group discussions, debates, interviews, persuasive speeches, seminar presentations • project folios including design briefs, design ideas, concept maps, management plans, working notes and sketches, procedures, data collection and analyses, test or survey results • diaries/journals/learning logs of items such as management processes and group consultations • written tasks such as short and extended responses, instructions, explanations, reviews, scripts, planning sheets, reports, recommendations • computer-generated presentations/projects such as graphical and multimedia products • photographic, video/audio tape records such as explanations of processes or demonstrations of products • peer- and self-reflection through feedback from small or large group discussions or responses to evaluation questions.	**Observation** Teachers observe students as they participate in planned activities. Teacher observation occurs continually as a natural part of the learning and teaching process and can be used to gather a broad range of evidence about students' learning. Teacher observations can also be structured to gather particular kinds of information in relation to learning. **Consultation** Teachers discuss student work with students, colleagues, parents/carers or other paraprofessionals. The varying perspectives of the participants in consultations can help enrich the evidence gathered about students' learning. Consultation can be used to verify the evidence gathered using other techniques. Some consultation may reveal a need for more detailed assessment. **Focused analysis** Teachers examine in detail student responses to tasks or activities. This technique provides detailed evidence about students' of learning. **Peer- and self-assessment** Students use the above techniques to assess their own work and the work of their peers. Peer- and self-assessment allow teachers to take account of students' perceptions when gathering evidence.	Teachers can record their judgments about students' learning using a variety of instruments. Recording instruments include: • anecdotal records • teacher/student journals • folios • checklists • statements of anticipated evidence or criteria sheets • annotated work samples • audio and visual recordings (including photographic and video or multimedia) • test results over time • observation notes • feedback sheets • peer- and self-assessment sheets • profiles • progress charts.

Making judgments about demonstrations of learning

Judgments about what students know, and can do with what they know, are an integral and ongoing part of the assessment process. For example, throughout the assessment process, teachers make judgments about:

- students’ responses to particular assessment tasks
- what students know and can do with particular content

Such judgments are part of the ongoing monitoring of student progress and inform planning for future learning activities and assessment opportunities. The criteria on which judgments are to be based should be drawn from students’ learning and made known to students before tasks are undertaken so that the basis for judgments is clear.

Teachers make judgments about students’ learning when satisfied that they have sufficient evidence. In making these judgments, teachers need to:

- analyse what it is that students are expected to know and be able to do with what they know
- consider how student learning has progressed
- use a range of evidence
- make judgments about what learning a student has demonstrated.

Some students may be able to demonstrate what they know and can do with what they know the first time they have an opportunity to do so. When they have additional opportunities that result in further demonstrations, they are considered to have demonstrated learning consistently. Other students may need more opportunities to demonstrate their learning before the same decision can be made. A judgment can be made when a consistent pattern of demonstrations has been established.

The exercise of each teacher’s professional judgment is fundamental to the assessment process. Decisions should be based on explicit criteria, using a range of evidence to determine demonstrations of learning. Judgments about a student’s demonstrations of learning should be made without reference to the performance of other students.

Consistency of teacher judgments

To be consistent, teacher judgments about students' learning must hold true in later situations and be comparable with the judgments of other teachers.

An individual teacher's judgments need to be consistent:

- within their own classes for different students
- for different assessment opportunities at different times
- with those of other teachers in the same school (i.e. consistency within schools)
- with those of teachers in other schools (i.e. consistency among schools).

Strategies for ensuring consistency of teacher judgments include:

- ***sharing understandings about the learning***: Teachers discuss what students have to know and do to demonstrate their learning.
- ***collaborative planning***: Teachers work together to plan for learning and assessment, and to reach shared understandings about what is required for learning to be demonstrated. Collaborative planning in middle or secondary schools may involve teachers of the same year level, teachers of consecutive year levels, or teachers with subject expertise in two or more areas. Teachers might also plan collaboratively, especially for the transition from Year 7 to Year 8.
- ***common assessment tasks***: Teachers cooperatively plan and/or moderate assessment tasks focusing on the intended learning. This allows teachers to develop shared understandings about what students are expected to know and do with what they know.
- ***statements of anticipated evidence, or criteria sheets***: Teachers identify the properties, components or dimensions by which students' demonstrations of learning will be judged. In developing a common statement of anticipated evidence, or criteria sheet, teachers collaboratively analyse the intended learning to identify and record the anticipated evidence or criteria that will be used as the basis for judgments. Anticipated evidence could be identified in a design brief, criteria sheet, assessment task or verbal description.
- ***moderation processes (formal and informal)***: Teachers discuss and compare judgments made about students' work and associated demonstrations of learning. Formal moderation processes occur when school authorities require teachers from within or among schools to discuss the consistency of judgments about demonstrations of learning. Informal moderation occurs any time that teachers discuss and compare their judgments of students' work.
- ***samples of typical responses***: Teachers compile, and refer to, samples of student work that show how learning may be demonstrated. The samples could be annotated samples of student responses to selected assessment tasks.

Reporting

Reporting is the process of communicating timely, accurate information about students' learning. Its main purpose is to acknowledge and support student learning. Reporting may be formal or informal.

Reporting to students and parents/carers

Teachers need to provide regular feedback to students and parents/carers about student learning and progress. This kind of reporting is an important and ongoing part of the learning and teaching process and can occur incidentally as well as in planned ways.

Students and parents/carers also need to be provided with information about student progress at certain points in time as identified by schools in their overall plans for learning, assessment and reporting.

Reporting on student progress in relation to learning

Information reported to students and parents/carers as part of the ongoing learning and teaching process could include:

- explanations of particular assessment opportunities
- evidence about demonstrations of learning
- judgments about demonstrations of particular learning
- clarification of what students are expected to know, and be able to do with what they know, and how their learning could be demonstrated
- identification of future assessment opportunities and anticipated evidence.

Information reported to students and parents/carers at particular points in time could include:

- records of the learning previously demonstrated by the student
- descriptions of the learning that students have had opportunities to demonstrate since reporting last occurred
- statements about what students were expected to know, and do with what they know, to demonstrate their learning
- descriptions of the contexts in which learning and assessment have occurred
- records of the learning demonstrated by the students since the previous report
- information that is specific to individual students, such as the student's self-assessment, goals or future learning plans.

Language, formats and modes of reporting

The language, formats and modes used for reporting should be meaningful and relevant to the proposed audience. Possible modes for reporting include:

- written reports (print or electronic)
- student–teacher conferences
- teacher–parent/carer interviews
- student-led three-way conferences (student, teacher and parents/carers)
- culminating presentations
- portfolios (print or electronic).

Guidelines

Planning courses of study

Subject area syllabuses broaden the curriculum choice and specialisation for students during the later years of compulsory schooling — that is, during middle and lower secondary schooling. The Industrial Technology and Design Education subject area syllabus allows teachers to develop a variety of courses of study that meet the specific needs and interests of students.

Learning outcomes for a course of study should be selected on the basis of how best they complement each other and how they collectively fulfil the intent of the course of study. They may be selected from the Industrial Technology and Design Education subject area syllabus or combined with learning outcomes from other syllabuses. For example, an industrial technology and design course of study can be planned using the learning outcomes from:

- the *Industrial Technology and Design Education Subject Area Syllabus and Guidelines*
- the *Industrial Technology and Design Education Subject Area Syllabus and Guidelines* and a key learning area syllabus (or syllabuses)
- the *Industrial Technology and Design Education Subject Area Syllabus and Guidelines* and another subject area syllabus (or syllabuses).

The learning outcomes within subject area syllabuses are not mandated. Schools may develop courses of study using a subset of the learning outcomes described within the strands. Central learning outcomes, together with some or all of the supplementary learning outcomes, can be used to develop courses of study.

Decisions about learning outcomes selected for a course of study will be influenced by:

- school and school authority policies
- the place and role of the subject area course of study within the total school curriculum.

Industrial technology and design courses of study

Worthwhile industrial technology and design courses of study:

- provide opportunities for students to understand and use industrial practice
- take account of legal requirements
- take account of the availability of school facilities and resources.

Industrial practice

Industrial practice describes a way of working in industrial technology and design contexts. Industrial practice involves considerations of:

- design and industry standards

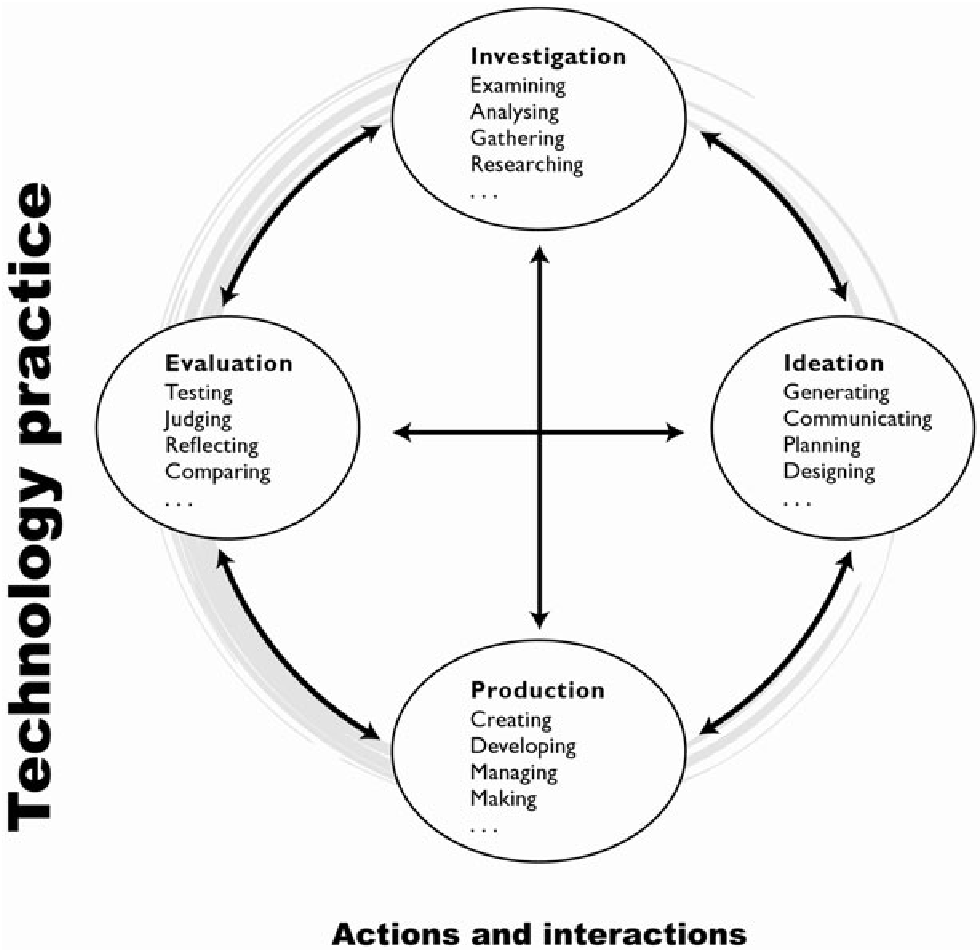
- workplace health and safety
- resource management
- issues of social, ethical and environmental responsibility.

In Industrial Technology and Design Education, students use technology practice to develop industrial systems and to design and manufacture products.

Technology practice

Technology practice (as described in the *Years 1 to 10 Technology Syllabus*) involves developing practical, purposeful and innovative products that meet human needs and wants. Technology practice involves:

- investigation — this is carried out to gather knowledge, ideas and data to meet design challenges
- ideation — this is undertaken to generate and communicate ideas that meet design challenges, and to justify the selection of these ideas
- production — production procedures can be identified, described and managed when making products that meet design challenges
- evaluation — this is undertaken to make judgments about the appropriateness of design ideas, processes and products when meeting design challenges.



(From *Years 1 to 10 Technology Syllabus* 2003, Queensland Studies Authority, Brisbane.)

Legal requirements

Industrial technology and design courses of study are conducted subject to a range of legislation and regulations. Courses of study in industrial technology and design must be planned taking account of legal requirements.

The underlying principle of legislation and regulations is protection for the people who work in the industry and for the consumers who use the products.

Safety

All learning activities undertaken in this subject area must be planned and conducted with due regard for the safety of all concerned. The legal requirements to do so are described in the documents listed below.

Teachers and students must follow safe work practices in a designated area free of avoidable hazards. They must be provided with appropriate safety equipment. Students should not participate in activities until they have been advised of the risks involved and provided with demonstrations of correct procedures. Staff and facilities must have current accreditation or certification for proposed activities and relevant material safety data sheets (MSDS) must be available and used to identify risks and precautions. Whenever specific tools or equipment are used, teachers/supervisors must ensure their safe use as described in the manufacturer's instructions.

The standards for establishing and maintaining a safe workplace in Queensland are set by the *Workplace Health and Safety Act 1995*. This Act provides for a number of regulations, advisory standards and codes of practice that apply to specific industries — for example, Workplace Health and Safety Regulation 1997, and Workplace Health and Safety (Miscellaneous) Regulation 1995.

The Department of Education and the Arts has developed policies related to risk assessment and risk management. The *Department of Education Manual* is available on their website. The following modules are specifically for planning courses of study in industrial technology and design:

- HS-10-21 Maintaining a Safe Workshop
- HS-10-22 Woodworking
- HS-10-23 Metalworking
- HS-10-24 Electric Arc Welding
- HS-10-25 Gas Heating, Welding and Cutting
- HS-10-26 Soft Soldering
- HS-10-27 Fixed Machines
- HS-10-28 Portable Electrical Power Equipment
- HS-10-29 Working Thermoplastics
- HS-10-30 Operating Compressed-air Equipment
- HS-10-31 Spray Painting
- HS-10-32 Fibre-reinforced Plastics and Thermoset Resins
- HS-10-33 Metal-casting Operations
- HS-10-34 Electrics and Electronics.

To view copies of these modules, go to http://education.qld.gov.au/corporate/doem/, click on 'Health & Safety' at the top of the page, then 'HS-10-1 – HS-10-121'. Alternatively, go directly to http://education.qld.gov.au/corporate/doem/healthsa/healthsa.html.

Examples of industrial technology and design courses of study

Multiple courses of study with different focuses can be developed from the Industrial Technology and Design Education subject area syllabus. The following are examples of courses of study that may be planned to meet the needs and interests of students and school communities. These examples provide some preliminary ideas for planning and illustrate the range of courses of study that can be planned.

- A **Graphical Communication** course of study may include learning outcomes from the Graphical Communication strand. This course could provide opportunities for students to respond to graphical communication challenges in a range of contexts and in a variety of forms.
- An **Industrial Workshop** course of study may include learning outcomes from the Product Design and Manufacture and the Industrial Systems and Control strands. A workshop-focused course of study would provide opportunities for students to use a variety of materials and systems components to develop responses to design challenges. The course may also include some learning outcomes from the Graphical Communication strand. Students would have opportunities to use graphical communication to communicate product ideas, plans and procedures.
- Other courses of study could be **Technology Studies** and **Industrial Systems**.

Planning learning and assessment

An outcomes approach requires that students demonstrate what they know and can do with what they know. In an outcomes approach there is a strong link between learning and assessment, and strategies for these should be planned together. Assessment involves the ongoing and systematic collection of information about students' demonstrations of learning.

Teachers are encouraged to monitor students' demonstrations of learning during everyday activities rather than at the end of a course of study. When planning, teachers should include opportunities for ongoing monitoring and gathering of information about students' demonstrations of learning. Feedback from assessment of these demonstrations, which may be diagnostic, formative or summative, leads to short-term or long-term revision of curriculum plans.

When planning for assessment, it is necessary to identify:

- suitable contexts in which students can demonstrate what they know and can do with what they know
- the anticipated evidence or criteria against which judgments can be made about whether students have demonstrated their learning.

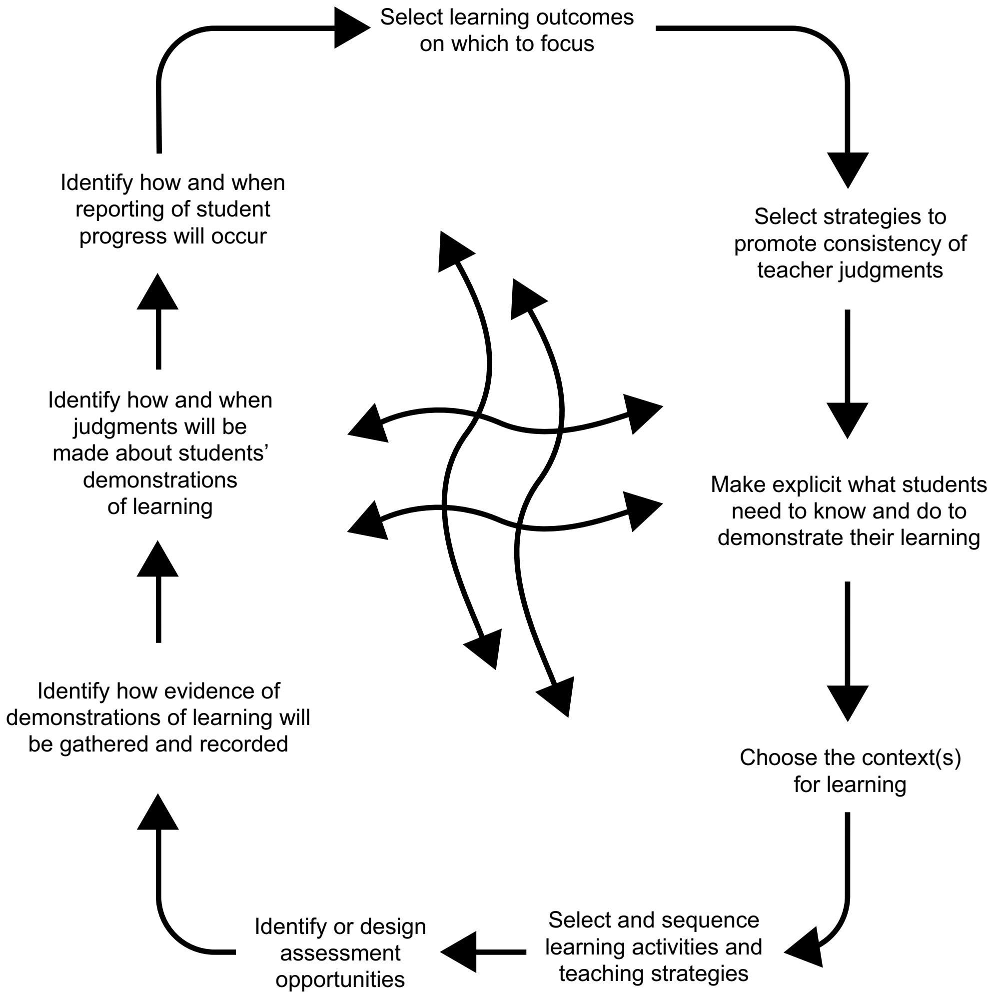
A model for planning units of work

Although individual teachers will approach planning in different ways, when teachers plan using learning outcomes, they:

- select learning outcomes on which to focus
- select strategies to promote consistency of teacher judgments
- make explicit what students need to know and do with what they know
- choose the context for learning
- select and sequence learning activities and teaching strategies
- identify or design assessment opportunities

- identify how evidence of demonstrations of learning will be gathered and recorded
- identify how and when judgments will be made about students' demonstrations of learning
- identify how and when reporting of student progress will occur.

These features are an essential part of long-term planning (e.g. yearly or semester programs) and short-term planning (e.g. units of work). The essential features of the planning process are illustrated in the following model. The model highlights the dynamic and cyclic nature of planning using learning outcomes.



Planning for learning, teaching, assessment and reporting

Planning with central learning outcomes

The major considerations for planning learning opportunities and related assessment are the central learning outcomes.

Activities planned for students should have within them opportunities for student learning and the collection of information about students' demonstrations of learning.

Activities should draw on the central content of the relevant strands.

Elaborations

Elaborations are designed to help teachers understand the intent of the central learning outcomes. They provide examples of possible content and contexts for developing and demonstrating the learning outcomes.

Industrial Systems and Control		
ISC 4.1 Students investigate the systems and subsystems used within industrial technology and design industries.	**ISC 5.1** Students investigate the influences that have led to the development of industrial systems.	**ISC 6.1** Students analyse trends in the development of industrial systems and describe how these might impact upon local industries.
Students know: • **industrial technology and design industries** e.g. manufacturing, engineering, construction, architecture, drafting, graphic design, rapid prototyping, research and development • **systems and subsystems** – types of systems and subsystems e.g. electrical, hydraulic, pneumatic, electronic, hydro, solar, mechanical, fabrication, structural, computer control, drafting (2D, 3D) – role of systems and subsystems e.g. produce, organise, distribute, control, store, communicate **Students:** • **investigate the systems and subsystems** – identify industrial technology and design industries – examine types of systems used in industrial technology and design – explain the role of systems	**Students know:** • **industrial systems** – role of industrial systems e.g. mass production, distribution, marketing, communication • **influences on industrial systems** e.g. culture, social, economic, ethics and sustainability, technology • **development of industrial systems** – modification, adaptation or creation of industrial systems e.g. manual to automated, systems of mass production, human mechanical to CNC, analog to digital, drafting to CAD **Students:** • **investigate the influences that have led to the development of industrial systems** – describe the modification, adaptation or creation of an industrial system – identify the influences that affect specific industrial systems – illustrate the effects of a particular influence on a system e.g. how production systems were affected by economic rationalism	**Students know:** • **trends** – past influences e.g. economic rationalisation, automation – future perspectives e.g. automation, use of alternative energy sources, changing work structures, globalisation, market economy, workplace efficiency • **impacts on local industries** e.g. staff ratios and employment, staff training needs, multiskilling, profit viability, competition, product or service specialisation, resources, facilities **Students:** • **analyse the impacts of trends** – identify trends in the development of industrial systems – compare global and local industries e.g. in terms of specialisation, production procedures, skill needs

Industrial Systems and Control

ISC 4.2 Students identify and explain the logic of systems and subsystems. (Tech SYS 4.1)	**ISC 5.2** Students explain structures, controls and management of systems and subsystems. (Tech SYS 5.1)	**ISC 6.2** Students explain principles underlying complex systems in terms of structures, control and management. (Tech SYS 6.1)
Students know: • **systems and subsystems** – need for subsystems within systems e.g. movement sensor is a subsystem in an alarm – systems that have application in industrial technology and design contexts e.g. mechanical, programmable logic control, pneumatic, electrical • **logic of systems and subsystems** – inputs, processes, outputs – function of components – organisation of the components in systems and subsystems and the links between them – components are organised to achieve a goal e.g. components in a sensor light are organised to sense movement that triggers light	**Students know:** • **structures** – how components within a system interact with each other e.g. master and slave cylinders in a hydraulic system • **control** – role of controls in modifying inputs, processes and outputs e.g. program selectors on an automatic clothes-washing machine • **management** – structures and controls within systems can be managed to optimise outputs e.g. the timing and filling capacity of a packaging system can be managed to cater for different quantities	**Students know:** • **principles underlying complex systems** – structure of input, processes and outputs involves multiple pathways and relationships between subsystems e.g. computer program is the input that manages the systems that fill, seal, label and check food packages – multiple controls are required to organise the operation of complex systems – strategies to manage and maintain complex systems e.g. fail-safe mechanisms, quality-control procedures
Students: • **identify and explain the logic of systems and subsystems** – generate flow charts, diagrams or models to identify the logic of systems e.g. create a flow chart of an electronic circuit – assemble or disassemble a system to analyse its operation e.g. disassemble a smoke detector to identify logic of the system – analyse the components in a circuit diagram	**Students:** • **explain structures, controls and management** – draw schematic diagrams, flow charts or concept maps to illustrate the structures of systems – examine production systems to identify the structures, controls and management e.g. large-scale injection-moulding process – compare the advantages and disadvantages of different control mechanisms e.g. manual, automatic, computer-controlled	**Students:** • **explain principles underlying complex systems** – identify and explain the relationships between component parts of complex systems – analyse how the structures, control and management within a system affect its operation e.g. describe how computer controls work to optimise quality and efficiency

Industrial Systems and Control

ISC 4.3 Students incorporate feedback to refine and modify systems and/or subsystems. (Tech SYS 4.2)	**ISC 5.3** Students incorporate control and management mechanisms in systems that include subsystems. (Tech SYS 5.2)	**ISC 6.3** Students devise ways to manage and monitor the operation of complex systems. (Tech SYS 6.2)
Students know: • **feedback** – data gathered about the operation of a system – techniques to gather feedback e.g. trials and tests, measurements, observations – role of feedback	**Students know:** • **control and management mechanisms** – components or subsystems that monitor and modify the outputs	**Students know:** • **ways to manage operation** e.g. trouble shoot, develop fail-safe measures, characteristics of quality systems • **ways to monitor operation** e.g. measure outputs, monitor fuel consumption, check the performance of individual components
Students: • **incorporate feedback** – select and use techniques to gather feedback e.g. stress-test a bridge structure and graph results – analyse feedback – identify ways to improve the systems e.g. modify the structure of the systems, substitute components made from different materials	**Students:** • **incorporate control and management mechanisms** – devise new inputs, processes and outputs by incorporating additional components e.g. add a gear to a motor to increase power, substitute a pulley in a system – adjust inputs, processes or outputs e.g. alter the length of a lever and the position of the fulcrum, fine-tune the fuel mixture of an engine, incorporate valves to adjust pressure – improve the operation of a system by modifying it or adding a feature	**Students:** • **devise ways to manage and monitor the operation of complex systems** – collect data about the operation of a complex system e.g. robot – develop a maintenance plan – optimise efficiency, productivity, performance

<table>
<tr><th colspan="3">Industrial Systems and Control</th></tr>
<tr>
<td>ISC 4.4 Students use technology practice (as described in the Level 4 core learning outcomes in the Years 1 to 10 Technology Syllabus) to develop industrial systems.</td>
<td>ISC 5.4 Students use technology practice (as described in the Level 5 core learning outcomes in the Years 1 to 10 Technology Syllabus) to develop industrial systems.</td>
<td>ISC 6.4 Students use technology practice (as described in the Level 6 core learning outcomes in the Years 1 to 10 Technology Syllabus) to develop industrial systems.</td>
</tr>
<tr><td colspan="3">The learning outcomes from the Technology Practice strand of the Years 1 to 10 Technology Syllabus are reproduced below. These are to be used as a set.</td></tr>
<tr>
<td>Students use consultative methods to gather knowledge, ideas and data when researching alternatives within design challenges. (Tech TP 4.1)</td>
<td>Students analyse links between the knowledge, ideas and data gathered to meet design challenges and the design and development of new and improved products. (Tech TP 5.1)</td>
<td>Students formulate detailed plans for gathering knowledge, ideas and data and validate choices of information, sources and methods. (Tech TP 6.1)</td>
</tr>
<tr>
<td>Students know:
• consultative methods e.g. interviews, surveys, discussions, focus groups, questionnaires, online community discussions, teleconferences, meetings, professional advice
• alternatives within design challenges
– ideas, options
– advantages and disadvantages of particular ideas and options</td>
<td>Students know:
• links between information gathered and the design and development of products
– knowledge, ideas and data inform development of products e.g. data about potential users
– new materials, products, techniques
– ways of developing products to meet new or emerging needs
• ways to analyse links between information gathered and the development of products
– identify the knowledge, ideas and data that are reflected in the design and development of products, and those that are not reflected
– consider how well the product design and development match the knowledge, ideas and data gathered e.g. conduct SWOT and PMI analyses</td>
<td>Students know:
• detailed plans for gathering knowledge, ideas and data
– information from a range of sources enhances accuracy and reliability
– detailed plans may identify possible sources of information, methods of collecting data and timelines for gathering information
• ways to validate choices of information, sources and methods used to gather information
– consult experts about the validity of information gathered and the methods used
– investigate the reliability of the source e.g. Who has produced the data? What qualifications does the group hold?
– cross-reference with information gathered from other sources</td>
</tr>
<tr>
<td>Students:
• use consultative methods
– gather information using various methods e.g. interview people who design similar products, survey people who will use the products; question people who can provide professional advice, discuss design options with others
– use resources that specialists have developed to gather information e.g. internet, email or online communities, brochures, journals
• research alternatives within design challenges
– analyse and compare ideas and information gathered through consultation</td>
<td>Students:
• analyse the links between information and the development of products
– analyse how information about the users' needs influences the development of new products
– survey groups of people in a particular community to determine their needs and wants
– consult with people who design products to discover how their knowledge of the needs of the community affects their design work</td>
<td>Students:
• formulate detailed plans for gathering knowledge, ideas and data
– develop an action plan by identifying sources, collection methods, timelines
• validate choices, sources and methods
– evaluate the sources of data and the relevance to the design challenge
– identify constraints that impact on the choice of sources and methods e.g. time, cost
– provide evidence that the information is accurate, current and from a respected source</td>
</tr>
</table>

Industrial Systems and Control

Students generate design ideas through consultation and communicate these in detailed design proposals. (Tech TP 4.2)	Students generate design ideas and communicate these in design proposals that indicate an understanding of factors influencing production of the option(s) they have selected. (Tech TP 5.2)	Students generate design ideas and communicate these in design proposals that indicate various options and incorporate management strategies. (Tech TP 6.2)
Students know: • **strategies that lead to the generation of design ideas** e.g. brainstorming, negotiations, discussions, gathering opinions about design proposals • **detailed design proposals** – communicate design ideas – provide background information about the design challenge, product purpose, intended users – show considerations of resources, timelines, product specifications, production procedures • **ways to communicate design ideas** e.g. annotated diagrams, written descriptions, models, prototypes, sketches, scale drawings	**Students know:** • **factors influencing the production of selected options** – human and physical resources e.g. knowledge, time, skills, equipment, technical expertise, availability of materials – considerations of appropriateness e.g. aesthetics, environment, culture, function, social impact – economic factors e.g. cost, sustainability	**Students know:** • **options within design proposals** – resources – production techniques • **management strategies** – strategies to manage resources e.g. people, time, materials, equipment
Students: • **generate design ideas through consultation** – consult with others to develop and refine ideas e.g. with a student team, end-users or other experts – consult with the teacher or other students to discuss alternative design proposals – visit experts to discuss how they plan and design their projects • **communicate design ideas in detailed design proposals** – select and use appropriate ways to communicate the details of design proposals – use annotated sketches to communicate ideas for a product	**Students:** • **generate and select design ideas** – devise a range of options – analyse ideas and select the preferred options using strategies e.g. SWOT and PMI analyses – record consultations with clients/users to confirm that design ideas reflect needs and wants – identify impacts and consequences of different ideas – keep anecdotal records and notes of discussions – explain why a design idea was accepted or rejected • **communicate design proposals** – develop written proposals, oral presentations, diagrams, visual presentations, folios – develop sketches, flow charts, drawings, plans, procedures – describe the materials required; methods of production or implementation; sequence of action – use correct and suitable symbols, graphics and language for the intended audience	**Students:** • **incorporate management strategies** – plan to minimise waste – prepare budgets – develop workable timelines by consulting team members – observe and refine workplace procedures – minimise negative impacts of particular practices e.g. negative impacts on the environment – formulate checklists to ensure that the processes used are appropriate e.g. workplace health and safety

Industrial Systems and Control

Students identify and make use of the practical expertise of others when following production procedures to make products for specific users. (Tech TP 4.3)	Students meet predetermined standards as they follow production procedures to make quality products. (Tech TP 5.3)	Students negotiate and refine production procedures in making quality products that meet detailed specifications. (Tech TP 6.3)
Students know: • **practical expertise of others** – people with specialised knowledge or equipment – research techniques – documentation of the designs and processes of others • **specific users** – identified individuals or groups for whom the product will meet a need/desire – demographic description of a target group by features such as age, gender, occupation e.g. technicians, hobbyists, home handypersons, generation X/Y, tradespeople	**Students know:** • **predetermined standards** – design briefs or proposals – client specifications – government standards – industrial and commercial standards of quality and performance – desired effects e.g. optimise efficiency, productivity, performance	**Students know:** • **reasons to negotiate and refine production procedures** – minimise waste – enhance product quality – meet timelines and budget requirements – accommodate unforeseen circumstances • **ways to negotiate and refine production procedures** – team consultation and feedback – trials of production procedures – timelines for production – processes that streamline the production – production can be systematised by breaking it into stages – products may be modified to allow different or more simple methods of manufacture
Students: • **identify and make use of practical expertise of others** – identify individuals and groups in the community with expertise – consult people with practical expertise – seek assistance from experts about procedures – observe experts at work – engage mentors for skill development – request feedback and advice • **follow production procedures to make products for specific users** – follow production procedures as detailed in the design proposals – integrate points for feedback from users – organise market research/test groups – meet product specifications as detailed in the design proposals	**Students:** • **follow production procedures** – implement design and production steps – manage resources within constraints e.g. finances, equipment, time • **make quality products that meet predetermined standards** – identify the predetermined standards or client specifications e.g. functionality, authenticity – monitor procedures to reflect standards and modify procedures if required – create aesthetic appeal	**Students:** • **negotiate and refine production procedures** – consult and negotiate with others to refine production procedures in progress – identify and implement alternative production procedures to solve problems as the plan is implemented • **make quality products that meet detailed specifications** – identify the specifications required in design proposals – implement production procedures to meet these specifications – achieve accuracy, quality

Industrial Systems and Control

Students gather feedback to gauge how well their design ideas and processes meet design challenges and how effectively products meet the needs of specific users. (Tech TP 4.4)	Students use predetermined criteria to judge how well processes and products meet the needs of specific users, and recommend modifications or improvements. (Tech TP 5.4)	Students identify methods for evaluating commercial or industrial products and processes and use these to judge the appropriateness of their own processes and products. (Tech TP 6.4)
Students know: • **how to gather feedback** – simple surveys – interviews – product comparisons – people's reactions to a product – team members' critiques – self-reflection – observations • **how to develop tools for gathering and interpreting feedback** – open or closed questions – compilation and interpretation of data – collate data and identify key messages e.g. record data in tables, calculate percentages, graph data	**Students know:** • **how to use predetermined criteria to modify or improve processes and products** – strengths and weaknesses of a process or product in relation to the criteria – recommendations for change on the basis of the criteria – similarities and differences between the design ideas and the final processes and products – determining how well users' needs are met	**Students know:** • **methods for evaluating commercial or industrial products and processes** – product tests and trials – interviews with users – market research e.g. telemarketing, surveys, focus groups – consultations with experts – independent evaluations
Students: • **gather feedback about design ideas, processes or products** – develop a list of criteria to measure the effectiveness of their design e.g. cost of production, quality of the product or enterprise, conditions of production, profitability, management of resources – gauge how well design ideas, processes and products meet design challenges – gauge how effectively products meet the needs of specific users – analyse if resources could have been better invested in a different enterprise – survey the rest of the class, or another class, about the success or otherwise of the enterprise or product – write a brief report comparing the final product or the outcome of the enterprise with the plan	**Students:** • **use predetermined criteria** – identify the criteria – use criteria established by the teacher or others – generate criteria to test their processes, products or services – devise criteria for the purpose of judging and improving documentation – devise criteria for improving production methods and product performance • **judge how well the processes or products match the criteria** – rate the product – describe strengths and weaknesses of processes – carry out product tests – conduct market research – consider a range of ways to evaluate their designs and recognise that the most appropriate design depends on the criteria used to develop the design • **use judgments to make recommendations for changes** – modify a part of a process that could be strengthened	**Students:** • **identify methods for evaluating** – select and use methods e.g. for reliability, feasibility – validate methods for evaluating their own products and processes • **make judgments about the appropriateness of their own processes and products** – decide if the processes for conceptualising and making the products have achieved the goals – analyse the data collected during evaluations and draw conclusions about the success of the products – make judgments in devising evaluation criteria in relation to aesthetics, culture, economics, environment, ethics, function, society – ask advice from experts, parents/carers, teachers about documentation, production methods and product performance – compare their documentation, production methods or product performances to those of commercial companies – use their own criteria to evaluate commercial companies' documentation, production methods and product performance

<table>
<tr><th colspan="3">Graphical Communication</th></tr>
<tr><td>GC 4.1 Students investigate the use of the elements and principles of design in graphical representations.</td><td>GC 5.1 Students use the elements and principles of design to produce graphical representations for design challenges.</td><td>GC 6.1 Students justify the use of the elements and principles of design when producing graphical representations in response to a design challenge.</td></tr>
<tr><td>Students know:
• graphical representations
– information is communicated through visual imagery
– purpose and audience influence the nature of graphical representations e.g. sketches, logos for marketing, architectural drawings, product designs
• elements of design e.g. points, lines, shapes, textures, tones, colours, spaces
• principles of design e.g. contrast, harmony, balance, symmetry, proportion, scale, unity, proximity, alignment, repetition

Students:
• investigate the use of elements and principles
– identify graphical representations e.g. logos, orthographic views, pictorials
– analyse the graphical representations to identify the use of the elements and principles of design e.g. use of colours, fonts, placement of images</td><td>Students know:
• how to use the elements and principles of design to communicate an idea or image
– elements can be placed and organised for design emphasis
• strategies to respond to a design challenge
– investigate, ideate, produce, evaluate

Students:
• use the elements and principles of design
– consider the specifications of the design challenge e.g. purpose, audience, constraints
– generate a graphical response</td><td>Students know:
• use of particular elements and principles of design
– elements and principles are selected and used in particular ways to communicate
– reasons for the visual impact
– how to communicate a specific message or idea to a particular audience

Students:
• justify the use of the elements and principles of design
– analyse graphical representations in terms of the way elements and principles have been manipulated
– present design justifications using annotations, written descriptions or oral presentations</td></tr>
</table>

Graphical Communication

GC 4.2 Students use simple construction techniques to present graphical responses to design challenges.	**GC 5.2** Students select construction techniques to manipulate simple figures in graphical responses to design challenges.	**GC 6.2** Students select construction techniques to combine figures and objects in response to design challenges.
Students know: • **simple construction techniques** – simple 2D and 3D projection techniques e.g. orthographic projections, pictorials, developments, 3D modelling **Students:** • **use simple construction techniques** – identify the construction techniques required to generate a response to the design challenge – implement procedures and sequences to construct graphical representations	**Students know:** • **construction techniques** – plain figures – geometrical solids – surface developments – ways to manipulate simple figures e.g. incline, truncate, rotate – ways to manipulate space in complex ways e.g. working or viewing plane, perspective **Students:** • **select construction techniques to manipulate simple figures** – identify the requirements of the design challenge – select and use construction and projection techniques to match the requirements of the challenge	**Students know:** • **techniques to combine figures and objects** e.g. subtract, add, intersect, multiply, manipulate **Students:** • **select construction techniques to combine figures and objects** – analyse the elements of combined objects – select construction techniques to manipulate the space – develop and use procedures and sequences to represent combined objects

Graphical Communication		
GC 4.3 Students analyse sources and forms of information and match these to the requirements of design challenges. (Tech INF 4.1)	**GC 5.3** Students explain how changes to sources, forms and management of information affect design and production decisions. (Tech INF 5.1)	**GC 6.3** Students analyse issues related to the ownership and control of information in societies. (Tech INF 6.1)
Students know: • **sources of information** – different sources of information e.g. design briefs, references (internet, texts, magazines) – how the source of information affects reliability, credibility, currency, bias • **forms of information** – how information is presented – multiple forms of information can be used in graphical communication e.g. paper-based, digital still, multimedia – how the form of information affects communication and use	**Students know:** • **changes to sources, forms and management** – reasons for change e.g. technological developments, changes in public policy, societal values, accessibility to equipment – changes e.g. accessibility to and volume of information, privacy issues, digital forms – how changes affect design and production decisions e.g. ways to present and transmit graphical images	**Students know:** • **issues related to ownership of information** – copyright – intellectual property e.g. designs, patents, images – plagiarism • **control of information in societies** – standards and conventions used to communicate across societies or cultures e.g. Australian Standards – how information is controlled e.g. intellectual property rights
Students: • **analyse sources and forms of information** – compare and contrast different sources and forms of information – identify what makes different forms of information suitable for particular purposes • **match sources and forms of information to design challenges** – consider the requirements of design challenges – select sources and forms of information to meet these requirements	**Students:** • **explain how changes affect design and production decisions** – identify changes to the sources, forms and management of information used in graphical communication – describe reasons for the changes e.g. hand drawn to CAD, paper to electronic storage	**Students:** • **analyse issues** – identify issues related to ownership and control of information e.g. identify use/misuse of copyright in drawings – describe the impacts of transmission of information on societies and individuals e.g. bias in presentation of a graphic information product – analyse the availability of technology to access graphical information e.g. digital photo images

<table>
<tr><th colspan="3">Graphical Communication</th></tr>
<tr>
<td>GC 4.4 Students apply techniques for transforming and transmitting information for different audiences. (Tech INF 4.2)</td>
<td>GC 5.4 Students compare and select techniques for processing, managing and presenting information for specific users. (Tech INF 5.2)</td>
<td>GC 6.4 Students use specialised techniques for managing and organising the presentation of information to meet detailed specifications. (Tech INF 6.2)</td>
</tr>
<tr>
<td>Students know:
• techniques for transforming information e.g. free-hand sketching, CAD, manual drafting, multimedia
• techniques for transmitting graphical information e.g. emails and attachments, websites, posters, paper-based plans
• audiences e.g. self, clients, commercial, government</td>
<td>Students know:
• techniques to process, manage and present information
– written, oral or numeric information can be represented graphically
– management of information involves storage and retrieval e.g. electronically, manually
– the ways information can be manipulated to enhance its appearance e.g. colour, line thickness, shading, rendering</td>
<td>Students know:
• specialised techniques
– ways to manage, organise and present information e.g. import CAD image into a text document
• detailed specifications
– techniques are determined by specifications e.g. presentation techniques and standards</td>
</tr>
<tr>
<td>Students:
• apply techniques for transforming and transmitting information
– identify audience needs e.g. interview clients or target audiences
– consider which techniques match the audiences' needs e.g. sketch concepts free-hand to communicate initial design ideas, develop a 3D model and email as an attachment</td>
<td>Students:
• compare and select techniques
– identify the needs of specific users
– analyse the advantages and disadvantages of different techniques
– select techniques to meet the needs of specific users</td>
<td>Students:
• use specialised techniques
– identify and use techniques that match detailed specifications e.g. create a folio of graphical drawings using correct scale, dimensions, symbols, views, materials, surface finishes and tolerances; develop a web page incorporating graphical images to promote a local enterprise</td>
</tr>
</table>

Product Design and Manufacture

PDM 4.1 Students demonstrate safe practices in workshop environments.	**PDM 5.1** Students identify potential hazards and demonstrate risk-control measures to manage safe work practices.	**PDM 6.1** Students develop and implement strategies and control measures to manage risks in workshop environments.
Students know: • **safe practices in workshop environments** – ways of working that ensure health and safety of self and others e.g. a knowledge of safe practices, disposition to care for the safety of self and others – health and safety practices when working with materials, equipment, processes and others in a shared environment	**Students know:** • **potential hazards** – situations that are unsafe, harmful or risky • **risk-control measures** – strategies to minimise risk and ensure health and safety	**Students know:** • **industrial work environments** – potentially complex environments that include multiple sources of risk – people take responsibility to manage their health and safety – health and safety is a shared responsibility between employers and employees
Students: • **demonstrate safe practices** – recognise risks – follow instructions on the safe use of materials, equipment and processes – store and handle materials and equipment correctly	**Students:** • **identify potential hazards** – assess their work space for hazards • **demonstrate risk-control measures** – respond to hazard warnings – seek assistance with materials, equipment and processes	**Students:** • **develop and implement strategies** – plan strategies to manage risks by safe use of materials, equipment and processes

Product Design and Manufacture		
PDM 4.2 Students explain how characteristics of materials affect ways they can be manipulated. (Tech MAT 4.1)	**PDM 5.2** Students compare and contrast materials according to their characteristics to determine how effectively the materials meet predetermined standards (Tech MAT 5.1)	**PDM 6.2** Students incorporate in their design proposals ideas about the impacts of particular materials used in products. (Tech MAT 6.1)
Students know: • **characteristics of materials** e.g. strength, flexibility, hardness, appearance • **techniques used to manipulate materials** e.g. cut, shape, join	**Students know:** • **how materials meet predetermined standards** – materials can be compared and contrasted according to their characteristics – how the characteristics of materials affect their performance – materials can be selected to meet standards	**Students know:** • **impacts of particular materials** – impact on the environment e.g. pollution, depletion of resources – aesthetic qualities – final product
Students: • **explain how characteristics of materials affect ways they can be manipulated** – describe the properties of materials – describe how the characteristics of a material will allow it to be manipulated e.g. the plasticity of acrylic will allow it to be moulded – test the suitability of tools on a range of materials – compare equipment that is made with different materials	**Students:** • **compare and contrast materials in relation to the standards** – identify the characteristics of materials that would meet the standards e.g. identify a corrosive-resistant material for use outdoors – compare the strengths and weaknesses of two or more materials in relation to the standards – compare the finished items to the specifications and criteria in the drawings/plans	**Students:** • **incorporate in their design proposals ideas about the impacts of materials** – describe how consideration of the impacts have influenced their design proposal e.g. recyclable plastics chosen for production of public outdoor seating – develop strategies to handle material waste effectively

Product Design and Manufacture		
PDM 4.3 Students employ their own and others' practical knowledge about equipment and techniques for manipulating and processing materials in order to enhance their products. (Tech MAT 4.2)	**PDM 5.3** Students operate equipment and apply techniques for manipulating and processing materials to meet predetermined standards. (Tech MAT 5.2)	**PDM 6.3** Students use specialised equipment and refined techniques to make quality products to detailed specifications. (Tech MAT 6.2)
Students know: • **equipment to manipulate materials** – considerations when selecting equipment e.g. knowledge of equipment, access to equipment, ease of use, appropriate equipment for the technique • **techniques to manipulate materials** – considerations when selecting techniques e.g. technique matches the purpose, time available, personal skill level, characteristics of materials **Students:** • **employ their own and others' practical knowledge** e.g. consult industry personnel or teacher	**Students know:** • **equipment to manipulate materials** – suitability of different equipment to meet predetermined standards – safe work practices when operating equipment • **techniques to manipulate materials** – suitability of different techniques to meet predetermined standards – safe work practices when applying techniques **Students:** • **operate equipment and apply techniques to meet standards** – work safely, accurately, efficiently – incorporate predetermined standards when manipulating materials with precision	**Students know:** • **specialised equipment** – a range of specialised equipment – effects that can be achieved using specialised equipment e.g. use a CNC lathe • **refined techniques** – effects that can be achieved by refined techniques e.g. copy attachment for a wood lathe **Students:** • **use specialised equipment and refined techniques** – select the techniques and equipment that match detailed specifications

Product Design and Manufacture

PDM 4.4 Students use technology practice (as described in the Level 4 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to design and manufacture products.	**PDM 5.4** Students use technology practice (as described in the Level 5 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to design and manufacture products.	**PDM 6.4** Students use technology practice (as described in the Level 6 core learning outcomes in the *Years 1 to 10 Technology Syllabus*) to design and manufacture products.
The learning outcomes from the Technology Practice strand of the *Years 1 to 10 Technology Syllabus* are reproduced below. These are to be used as a set.		
Students use consultative methods to gather knowledge, ideas and data when researching alternatives within design challenges. (Tech TP 4.1)	Students analyse links between the knowledge, ideas and data gathered to meet design challenges and the design and development of new and improved products. (Tech TP 5.1)	Students formulate detailed plans for gathering knowledge, ideas and data and validate choices of information, sources and methods. (Tech TP 6.1)
Students know: • **consultative methods** e.g. interviews, surveys, discussions, focus groups, questionnaires, online community discussions, teleconferences, meetings, professional advice • **alternatives within design challenges** – ideas, options – advantages and disadvantages of particular ideas and options	**Students know:** • **links between information gathered and the design and development of products** – knowledge, ideas and data inform development of products e.g. data about potential users – new materials, products, techniques – ways of developing products to meet new or emerging needs • **ways to analyse links between information gathered and the development of products** – identify the knowledge, ideas and data that are reflected in the design and development of products, and those that are not reflected – consider how well the product design and development match the knowledge, ideas and data gathered e.g. conduct SWOT and PMI analyses	**Students know:** • **detailed plans for gathering knowledge, ideas and data** – information from a range of sources enhances accuracy and reliability – detailed plans may identify possible sources of information, methods of collecting data and timelines for gathering information • **ways to validate choices of information, sources and methods used to gather information** – consult experts about the validity of information gathered and the methods used – investigate the reliability of the source e.g. Who has produced the data? What qualifications does the group hold? – cross-reference with information gathered from other sources
Students: • **use consultative methods** – gather information using various methods e.g. interview people who design similar products, survey people who will use the products, question people who can provide professional advice, discuss design options with others – use resources that specialists have developed to gather information e.g. internet, email or online communities, brochures, journals • **research alternatives within design challenges** – analyse and compare ideas and information gathered through consultation	**Students:** • **analyse the links between information and the development of products** – analyse how information about the users' needs influences the development of new products – survey groups of people in a particular community to determine their needs and wants – consult with people who design products to discover how their knowledge of the needs of the community affects their design work	**Students:** • **formulate detailed plans for gathering knowledge, ideas and data** – develop an action plan by identifying sources, collection methods, timelines • **validate choices, sources and methods** – evaluate the sources of data and the relevance to the design challenge – identify constraints that impact on the choice of sources and methods e.g. time, cost – provide evidence that the information is accurate, current and from a respected source

Product Design and Manufacture		
Students generate design ideas through consultation and communicate these in detailed design proposals. (Tech TP 4.2)	Students generate design ideas and communicate these in design proposals that indicate an understanding of factors influencing production of the option(s) they have selected. (Tech TP 5.2)	Students generate design ideas and communicate these in design proposals that indicate various options and incorporate management strategies. (Tech TP 6.2)
Students know: • **strategies that lead to the generation of design ideas** e.g. brainstorming, negotiations, discussions, gathering opinions about design proposals • **detailed design proposals** – communicate design ideas – provide background information about the design challenge, product purpose, intended users – show consideration of resources, timelines, product specifications, production procedures • **ways to communicate design ideas** e.g. annotated diagrams, written descriptions, models, prototypes, sketches, scale drawings	**Students know:** • **factors influencing the production of selected options** – human and physical resources e.g. knowledge, time, skills, equipment, technical expertise, availability of materials – considerations of appropriateness e.g. aesthetics, environment, culture, function, social impact – economic factors e.g. cost, sustainability	**Students know:** • **options within design proposals** – resources – production techniques • **management strategies** – strategies to manage resources e.g. people, time, materials, equipment
Students: • **generate design ideas through consultation** – consult with others to develop and refine ideas e.g. with a student team, end-users or other experts – consult with the teacher or other students to discuss alternative design proposals – visit experts to discuss how they plan and design their projects • **communicate design ideas in detailed design proposals** – select and use appropriate ways to communicate the details of design proposals – use annotated sketches to communicate ideas for a product	**Students:** • **generate and select design ideas** – devise a range of options – analyse ideas and select the preferred options using strategies e.g. SWOT and PMI analyses – record consultations with clients/users to confirm that design ideas reflect needs and wants – identify impacts and consequences of different ideas – keep anecdotal records and notes of discussions – explain why a design idea was accepted or rejected • **communicate design proposals** – develop written proposals, oral presentations, diagrams, visual presentations, folios – develop sketches, flow charts, drawings, plans, procedures – describe the materials required; methods of production or implementation; sequence of action – use correct and suitable symbols, graphics and language for the intended audience	**Students:** • **incorporate management strategies** – plan to minimise waste – prepare budgets – develop workable timelines by consulting team members – observe and refine workplace procedures – minimise negative impacts of particular practices e.g. negative impacts on the environment – formulate checklists to ensure that the processes used are appropriate e.g. workplace health and safety

Product Design and Manufacture

Students identify and make use of the practical expertise of others when following production procedures to make products for specific users. (Tech TP 4.3)	Students meet predetermined standards as they follow production procedures to make quality products. (Tech TP 5.3)	Students negotiate and refine production procedures in making quality products that meet detailed specifications. (Tech TP 6.3)
Students know: • **practical expertise of others** – people with specialised knowledge or equipment – research techniques – documentation of the designs and processes of others • **specific users** – identified individuals or groups for whom the product will meet a need/desire – demographic description of a target group by features such as age, gender, occupation e.g. hobbyists, home handypersons, generation X/Y, tradespeople, farmers	**Students know:** • **predetermined standards** – design briefs or proposals – client specifications – government standards – industrial and commercial standards of quality and performance – desired effects e.g. aesthetic appeal, innovation, ease of use, cost effectiveness	**Students know:** • **reasons to negotiate and refine production procedures** – minimise waste – enhance product quality – meet timelines and budget requirements – accommodate unforeseen circumstances • **ways to negotiate and refine production procedures** – team consultation and feedback – trials of production procedures – timelines for production – processes that streamline the production – production can be systematised by breaking it into stages – products may be modified to allow different or more simple methods of manufacture
Students: • **identify and make use of practical expertise of others** – identify individuals and groups in the community with expertise – consult people with practical expertise – seek assistance from experts about procedures – observe experts at work – engage mentors for skill development – request feedback and advice • **follow production procedures to make products for specific users** – follow production procedures as detailed in the design proposals – integrate points for feedback from users – organise market research/test groups – meet product specifications as detailed in the design proposals	**Students:** • **follow production procedures** – implement design and production steps – manage resources within constraints e.g. finances, equipment, time • **make quality products that meet predetermined standards** – identify the predetermined standards or client specifications e.g. functionality, authenticity – monitor procedures to reflect standards and modify procedures if required – create aesthetic appeal e.g. finishes such as galvanised, powder-coated, anodised, painted	**Students:** • **negotiate and refine production procedures** – consult and negotiate with others to refine production procedures in progress – identify and implement alternative production procedures to solve problems as the plan is implemented e.g. cutting all materials before assembly or cutting as assembly proceeds • **make quality products that meet detailed specifications** – identify the specifications required in design proposals – implement production procedures to meet these specifications – achieve accuracy, quality

Product Design and Manufacture		
Students gather feedback to gauge how well their design ideas and processes meet design challenges and how effectively products meet the needs of specific users. (Tech TP 4.4)	Students use predetermined criteria to judge how well processes and products meet the needs of specific users, and recommend modifications or improvements. (Tech TP 5.4)	Students identify methods for evaluating commercial or industrial products and processes and use these to judge the appropriateness of their own processes and products. (Tech TP 6.4)
Students know: • **how to gather feedback** – simple surveys – interviews – product comparisons – people's reactions to a product – team members' critiques – self-reflection – observations • **how to develop tools for gathering and interpreting feedback** – open or closed questions – compilation and interpretation of data – collate data and identify key messages e.g. record data in tables, calculate percentages, graph data	**Students know:** • **how to use predetermined criteria to modify or improve processes and products** – strengths and weaknesses of a process or product in relation to the criteria – recommendations for change on the basis of the criteria – similarities and differences between the design ideas and the final processes and products – determining how well users' needs are met	**Students know:** • **methods for evaluating commercial or industrial products and processes** – product tests and trials – interviews with users – market research e.g. telemarketing, surveys, focus groups – consultations with experts – independent evaluations
Students: • **gather feedback about design ideas, processes or products** – develop a list of criteria to measure the effectiveness of their design e.g. cost of production, quality of the product or enterprise, conditions of production, profitability, management of resources – gauge how well design ideas, processes and products meet design challenges – gauge how effectively products meet the needs of specific users – analyse if resources could have been better invested in a different enterprise – survey the rest of the class, or another class, about the success or otherwise of the enterprise or product – write a brief report comparing the final product or the outcome of the enterprise with the plan	**Students:** • **use predetermined criteria** – identify the criteria – use criteria established by the teacher or others – generate criteria to test their processes, products or services – devise criteria for the purpose of judging and improving documentation – devise criteria for improving production methods and product performance • **judge how well the processes or products match the criteria** – rate the product – describe strengths and weaknesses of processes – carry out product tests – conduct market research – consider a range of ways to evaluate their designs and recognise that the most appropriate design depends on the criteria used to develop the design • **use judgments to make recommendations for changes** – modify a part of a process that could be strengthened	**Students:** • **identify methods for evaluating** – select and use methods e.g. for reliability, feasibility – validate methods for evaluating their own products and processes • **make judgments about the appropriateness of their own processes and products using data gathered** – decide if the processes for conceptualising and making the products have achieved the goals – analyse the data collected during evaluations and draw conclusions about the success of the products – make judgments in devising evaluation criteria in relation to aesthetics, culture, economics, environment, ethics, function, society – ask advice from experts, parents/carers, teachers about documentation, production methods and product performance – compare their documentation, production methods or product performance to those of commercial companies – use their own criteria to evaluate commercial companies' documentation, production methods and product performance

Appendix I

Technology Practice: Learning outcomes

Technology Practice: Learning outcomes

(Excerpt from the *Years 1 to 10 Technology Syllabus*)

Learning outcomes

Technology Practice

Investigation is carried out to gather knowledge, ideas and data for use in meeting design challenges.

Ideation is undertaken to generate and communicate ideas that meet design challenges, and to justify the selection of these ideas.

Production procedures can be identified, described and managed when making products that meet design challenges.

Evaluation is undertaken to make judgments about the appropriateness of design ideas, processes and products when meeting design challenges.

Level 4	Level 5
Level statement *Students consult others when gathering information, generating design ideas and developing detailed design proposals. They make use of the practical expertise of others when following production procedures to make products. Students gather feedback to evaluate their ideas, processes and products.*	**Level statement** *Students analyse the links that exist between information gathered and the design and development of products. They develop design proposals that show an understanding of factors influencing the production of their products. Students use predetermined criteria to evaluate their processes and products.*
Core learning outcomes	**Core learning outcomes**
TP 4.1 Students use consultative methods to gather knowledge, ideas and data when researching alternatives within design challenges.	**TP 5.1** Students analyse links between the knowledge, ideas and data gathered to meet design challenges and the design and development of new and improved products.
TP 4.2 Students generate design ideas through consultation and communicate these in detailed design proposals.	**TP 5.2** Students generate ideas and communicate these in design proposals that indicate an understanding of factors influencing production of the option(s) they have selected.
TP 4.3 Students identify and make use of the practical expertise of others when following production procedures to make products for specific users.	**TP 5.3** Students meet predetermined standards as they follow production procedures to make quality products.
TP 4.4 Students gather feedback to gauge how well their design ideas and processes meet design challenges and how effectively products meet the needs of specific users.	**TP 5.4** Students use predetermined criteria to judge how well processes and products meet the needs of specific users, and recommend modifications or improvements.

*L*earning outcomes

Technology Practice

Investigation is carried out to gather knowledge, ideas and data for use in meeting design challenges.

Ideation is undertaken to generate and communicate ideas that meet design challenges, and to justify the selection of these ideas.

Production procedures can be identified, described and managed when making products that meet design challenges.

Evaluation is undertaken to make judgments about the appropriateness of design ideas, processes and products when meeting design challenges.

Level 6	Beyond Level 6
Level statement *Students prepare detailed plans for gathering information and validate their sources and methods. They develop various design proposals that incorporate strategies for managing resources and make quality products that meet detailed specifications. Students use methods that reflect commercial and industrial standards to evaluate their processes and products.*	**Level statement** *Students analyse information in detail and develop understandings and ideas that can lead to innovative and enterprising ways of meeting design challenges. They develop detailed proposals, manage production procedures that reflect industrial and commercial standards and make innovative products. Students use a range of methods to make judgments about the feasibility and community acceptance of their processes and products.*
Core learning outcomes	**Discretionary learning outcomes**
TP 6.1 Students formulate detailed plans for gathering knowledge, ideas and data and validate choices of information, sources and methods.	**TP B6.1** Students develop formal analyses of knowledge, ideas and data to meet design challenges in innovative and enterprising ways.
TP 6.2 Students generate design ideas and communicate these in design proposals that indicate various options and incorporate management strategies.	**TP B6.2** Students generate design ideas and communicate these in detailed design proposals that show evidence of innovation and include in-depth analysis of appropriateness.
TP 6.3 Students negotiate and refine production procedures in making quality products that meet detailed specifications.	**TP B6.3** Students manage production procedures that reflect commercial or industrial standards in order to make innovative products.
TP 6.4 Students identify methods for evaluating commercial or industrial products and processes and use these to judge the appropriateness of their own processes and products.	**TP B6.4** Students use a range of methods to judge whether their design ideas, production procedures and products are commercially or industrially feasible, and acceptable to the community.

Appendix 2

Technology Practice: Core content

Technology Practice: Core content

(Excerpt from the *Years 1 to 10 Technology Syllabus*)

Core content

Technology Practice

Investigation — gathering knowledge, ideas and data to meet design challenges

- analysis of design challenges
  - identifying needs, wants and opportunities (observing, consulting, conducting needs analyses or environmental scans)
  - identifying design requirements (user requirements, safety requirements, requirements under relevant legislation, regulations or conventions)
  - identifying design constraints
- sources of knowledge, ideas and data (familiar and unfamiliar)
  - environments
  - products of technology
  - internet (websites and online communities)
  - people (potential users, clients, specialists and experts)
  - libraries
- methods of gathering knowledge, ideas and data
  - consulting (questioning, questionnaires, surveys, interviews)
  - exploring, examining
  - researching
  - observing, scanning
  - experimenting, testing
- methods of organising and analysing knowledge, ideas and data
  - recording
  - selecting, sorting and comparing
  - interpreting, inferring and concluding
  - identifying alternatives
  - validating choices
  - challenging ideas
  - verifying accuracy
  - establishing relevance

Ideation — generating and communicating ideas that meet design challenges

- generation of ideas to meet design challenges
  - generating new ideas
  - modifying and refining designs
  - selecting and justifying design options
  - identifying materials, information and systems to meet design requirements
  - identifying equipment and techniques
- communication of ideas that meet design challenges
  - pictures, sketches, annotated drawings
  - play, roleplay
  - drawings of different views
  - scale drawings
  - computer-aided design (CAD)
  - models
  - technical terms
  - design proposals and specifications
  - detailed plans
  - oral, written and multimedia presentations

Production — making products to meet design challenges

- production procedures
  - developed (independently and cooperatively)
  - informed by practical experience
  - described, negotiated, refined
  - standards specified
  - identified, sequenced, followed
  - managed
- products (artefacts, processes, systems, services and environments)
  - meet human needs or wants
  - capitalise on opportunities
  - extend human capabilities
  - make models and prototypes
  - meet standards (predetermined criteria, commercial or industrial standards)

Evaluation — judging the appropriateness of design ideas, processes and products when meeting design challenges

- evaluation of design ideas, processes and products
  - expressing thoughts and opinions
  - gaining feedback from others (clients, specific users)
  - testing and judging effectiveness in real-life or lifelike contexts
  - comparing initial design ideas and final products
  - applying standards (predetermined criteria, commercial or industrial standards)
  - evaluating management decisions

Impacts and consequences

- historical, current and future developments
- impacts and consequences related to aesthetic, cultural, economic, environmental, ethical, functional and social appropriateness
- effects of management decisions

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