Australian Curriculum:
Technologies with a focus on critical and creative thinking

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Overview

- Curriculum development
- Australian Curriculum: Technologies
- General capabilities
- Types of thinking
- Achievement standards and work samples
Learning for life

Australian governments committed to working in collaboration to promote equity and excellence in Australian schooling, with school sectors supporting all young Australians to become

• successful learners
• confident and creative individuals
• active and informed citizens.
Dimensions of the Australian Curriculum

Learning areas
- English
- Mathematics
- Science
- Humanities and Social Sciences – History, Geography, Economics and Business, Civics and Citizenship
- The Arts
- Languages
- Health and Physical Education
- Technologies – Design and Technologies, Digital Technologies

General capabilities
- Literacy
- Numeracy
- Information and Communication Technology Capability
- Critical and Creative Thinking
- Personal and Social Capability
- Ethical Understanding
- Intercultural Understanding

Cross-curriculum priorities
- Aboriginal and Torres Strait Islander Histories and Cultures
- Asia and Australia’s engagement with Asia
- Sustainability
Technologies curriculum

Curriculum has been developed:
• from Foundation to Year 8 in two subjects: Design and Technologies and Digital Technologies
• from Years 9 to 10 in two optional subjects: Design and Technologies and Digital Technologies
National priorities

• Food and water security
• Health and wellbeing
• Knowledge economy
• Engineering, construction and manufacturing
• Innovation
Design and Technologies

Comprises two related strands:

• Design and Technologies knowledge and understanding – the use, development and impact of technologies and design ideas across a range of technologies contexts: engineering principles and systems; food and fibre production; food specialisations; materials and technologies specialisations

• Design and Technologies processes and production skills – the skills needed to design and produce designed solutions.
Digital Technologies structure

Comprises two related strands:

- Digital Technologies knowledge and understanding – the information system components of data, and digital systems (hardware, software and networks)

- Digital Technologies processes and production skills – using digital systems to create ideas and information, and to define, design and implement digital solutions, and evaluate these solutions and existing information systems against specified criteria.
Key ideas

• Creating preferred futures
• Project management
• Types of thinking:
  ➢ design thinking
  ➢ computational thinking
  ➢ systems thinking
Creating preferred futures

• How solutions created now will be used in the future
• The possible benefits and risks of creating solutions
• Weigh up possible short and long term impacts
• Possible, probable and preferred futures
• Reflected in *Technologies and society* thread
• Relates to cross-curriculum priority: Sustainability
• Economic, environmental and social sustainability
## Project management

Explicit teaching of this skill in both subjects

| 2.9 Sequence steps for making designed solutions and working collaboratively | 4.9 Plan a sequence of production steps when making designed solutions individually and collaboratively | 6.10 Develop project plans that include consideration of resources when making designed solutions individually and collaboratively | 8.11 Use project management processes individually and collaboratively to coordinate production of designed solutions | 10.12 Develop project plans using digital technologies to plan and manage projects individually and collaboratively, taking into consideration time, cost, risk and production processes |
Types of thinking
Responding to the challenges of the twenty-first century – with its complex environmental, social and economic pressures – requires young people to be creative, innovative, enterprising and adaptable, with the motivation, confidence and skills to use critical and creative thinking purposefully. (ACARA, 2014a)
### Generating ideas, possibilities and actions

<table>
<thead>
<tr>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typically by the end of Year 4, students:</td>
<td>Typically by the end of Year 6, students:</td>
<td>Typically by the end of Year 8, students:</td>
</tr>
<tr>
<td>Imagine possibilities and connect ideas</td>
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</tr>
<tr>
<td>expand on known ideas to create new and imaginative combinations</td>
<td>combine ideas in a variety of ways and from a range of sources to create new possibilities</td>
<td>draw parallels between known and new ideas to create new ways of achieving goals</td>
</tr>
<tr>
<td>Show examples ›</td>
<td>Show examples ›</td>
<td>Show examples ›</td>
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<tr>
<td>Consider alternatives</td>
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<td>Consider alternatives</td>
</tr>
<tr>
<td>explore situations using creative thinking strategies to propose a range of alternatives</td>
<td>identify situations where current approaches do not work, challenge existing ideas and generate alternative solutions</td>
<td>generate alternatives and innovative solutions, and adapt ideas, including when information is limited or conflicting</td>
</tr>
<tr>
<td>Show examples ›</td>
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<td>Show examples ›</td>
</tr>
<tr>
<td>Seek solutions and put ideas into action</td>
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</tr>
<tr>
<td>experiment with a range of options when seeking solutions and putting ideas into action</td>
<td>assess and test options to identify the most effective solution and to put ideas into action</td>
<td>predict possibilities, and identify and test consequences when seeking solutions and putting ideas into action</td>
</tr>
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<td>Show examples ›</td>
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</table>
Conceptual underpinnings

- Structure of Observed Learning Outcomes (SOLO) taxonomy developed by Biggs and Collis (1982)
- ‘Progression does not mean that in order to make progress one simply does something extra and different. Often, it is doing the same thing to a higher level of quality. Improvement may amount to doing the same thing but in progressively richer ways’ (Jones, 2009: 410).
- Contributed to a deeper understanding of ‘the vertical structure of a learning domain’ (Masters, 2013: 35).
Systems thinking

- Holistic approach to the identification and solving of problems
- Components of a system, and their interactions and interrelationships
- When generating ideas and decisions made throughout design processes in Design and Technologies, students need to understand systems and work with complexity, uncertainty and risk.
- To design digital solutions in Digital Technologies students need to understand the complexity of information and digital systems and the interdependence of components.
Systems…

are about making connections

are human constructs

are related to other systems

When we try to pick out anything by itself, we find it is tied to everything else in the universe.

John Muir (1838-1914)

involve interacting components

enable us to describe, compare, analyse and make predictions
A significant common feature

Systems

• Mathematics: consists of multiple interrelated and interdependent concepts and systems

• Science: systems as an overarching idea

• Technologies: systems thinking and engineering principles and systems
### Progression of ideas about systems...

*Atlas of Science Literacy (2007)*

<table>
<thead>
<tr>
<th>F-2</th>
<th>Year 3-5</th>
<th>Year 6-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>When parts are put together, they do things that they couldn’t do by themselves</td>
<td>Something may not work well (or at all) if a part of it is missing, broken, worn out, mismatched, or misconnected</td>
<td>Any system is usually connected to other systems both internally and externally. Thus a system may be thought of as containing sub-systems and as being a sub-system of a larger system</td>
</tr>
<tr>
<td>Something may not work if its parts are missing</td>
<td>If something consists of many parts, the parts usually influence one another</td>
<td>The output from one part of a system can become the input to other parts</td>
</tr>
<tr>
<td>When parts are put together, they do things that they couldn’t do by themselves</td>
<td>Collections of pieces (e.g. wooden blocks) may have properties that individual pieces don’t have</td>
<td>Thinking about things as systems means looking for how every part relates to others</td>
</tr>
</tbody>
</table>
### Snapshot: systems thinking

<table>
<thead>
<tr>
<th>Forming a system overview</th>
<th>Comprehending the nature of a system (knowing that boundaries can be difficult to define)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying and modelling interdependencies</td>
<td>Analysing and representing events and, cause and effect relationships in and across a system</td>
</tr>
<tr>
<td>Assessing system change over time</td>
<td>Monitoring and evaluating change in a system with reference to significant timeframes for events</td>
</tr>
<tr>
<td>Identifying leverage and possible consequences of action</td>
<td>Identifying the impact of action within and across system relationships</td>
</tr>
<tr>
<td>Assessing probability, risk and benefit</td>
<td>Anticipating potential change resulting from action or the possibility of chance events</td>
</tr>
<tr>
<td>Australian Curriculum: Design and Technologies</td>
<td>Australian Curriculum: Critical and Creative Thinking continuum</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Years 3 and 4</strong> Investigate how forces and the properties of materials affect the behaviour of a product or system</td>
<td><em>Level 3: Organise and process information</em> collect, compare and categorise acts and opinions found in a widening range of sources</td>
</tr>
<tr>
<td><strong>Years 7 and 8</strong> Analyse how motion, force and energy, are used to manipulate and control electromechanical systems when designing simple, engineered solutions</td>
<td><em>Level 5: Organise and process information</em> critically analyse information and evidence according to criteria such as validity and relevance</td>
</tr>
</tbody>
</table>
Design thinking

• underpins learning in Design and Technologies and used in Digital Technologies

• processes and production skills strand reflects the design process:
  investigating, generating, producing, evaluating, collaborating and managing

• involves strategies to support the design process
  – understanding design needs and opportunities
  – visualising and generating creative and innovative ideas
  – planning
  – analysing and evaluating those ideas that best meet the criteria for success
In Design and Technologies, design processes require students to:

- identify and investigate a need or opportunity
- generate, plan and realise designed solutions
- evaluate products and processes.

When developing solutions in Digital Technologies, students:

- explore, analyse and develop ideas based on data, inputs and human interactions
- design a solution to a problem
- consider how users will be presented with data, the degree of interaction with that data and the various types of computational processing.
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<tr>
<td><strong>Years 3 and 4</strong> Generate, develop, and communicate design ideas and decisions using technical terms and graphical representation techniques</td>
<td><strong>Level 3: Seek solutions and put ideas into action</strong> experiment with a range of options when seeking solutions and putting ideas into action</td>
<td><strong>Years 3 and 4</strong> Define simple problems, and describe and follow a sequence of steps and decisions (algorithms) needed to solve them</td>
</tr>
<tr>
<td><strong>Years 7 and 8</strong> Generate, develop, test, and communicate design ideas, plans and processes for various audiences using appropriate technical terms and technologies including graphical representation techniques</td>
<td><strong>Level 5: Seek solutions and put ideas into action</strong> predict possibilities, and identify and test consequences when seeking solutions and putting ideas into action</td>
<td><strong>Years 7 and 8</strong> Design the user experience of a digital system, generating, evaluating and communicating alternative designs</td>
</tr>
</tbody>
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Computational thinking

• underpins learning in Digital Technologies and is used in Design and Technologies

• problem-solving method that is applied to create solutions that can be implemented using digital technologies
  – involves integrating strategies, such as
  – organising data logically
  – breaking down problems into parts
  – interpreting patterns and models
  – designing and implementing algorithms.
Key concepts

A number of key concepts underpin the Digital Technologies curriculum:

- **Abstraction**, which underpins all content, particularly the content descriptions relating to the concepts of *data representation* and *specification, algorithms and implementation*

- **Data collection** (properties, sources and collection of data), *data representation* (symbolism and separation) and *data interpretation* (patterns and contexts)

- **Specification** (descriptions and techniques), *algorithms* (following and describing) and *implementation* (translating and programming)

- **Digital systems** (hardware, software and networks and the internet)

- **Interactions** (people and digital systems, data and processes) and *impact* (impacts and empowerment).
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<td><strong>Years 3 and 4</strong></td>
<td><strong>Level 3: Apply logic and reasoning</strong></td>
<td><strong>Years 3 and 4</strong></td>
</tr>
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<td>Critique needs or opportunities for designing and explore and test a variety of materials, components, tools and equipment and the techniques needed to produce designed solutions</td>
<td>Identify and apply appropriate reasoning and thinking strategies for particular outcomes</td>
<td>Implement digital solutions as simple visual programs with algorithms involving branching (decisions) and user input</td>
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<td><strong>Years 7 and 8</strong></td>
<td><strong>Level 5: Apply logic and reasoning</strong></td>
<td><strong>Years 7 and 8</strong></td>
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<td>Critique needs or opportunities for designing and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design</td>
<td>Identify gaps in reasoning and missing elements in information</td>
<td>Analyse and visualise data using a range of software to create information; and use structured data to model objects or events</td>
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</table>
By the end of Year 6, students explain the fundamentals of digital system components (hardware, software and networks) and how digital systems are connected to form networks. They explain how digital systems use whole numbers as a basis for representing a variety of data types.

Students define problems in terms of data and functional requirements and design solutions by developing algorithms to address the problems. They incorporate decision-making, repetition and user interface design into their designs and implement their digital solutions, including a visual program. They explain how information systems and their solutions meet needs and consider sustainability. Students manage the creation and communication of ideas and information in collaborative digital projects using validated data and agreed protocols.
Achievement standards and work samples
Intensive engagement

- 2013: 50 schools; 134 teachers
- 2014: 10 schools
- Manageability and usability of the curriculum
- Assessment tasks
- Mentors
- Work samples
Purpose of work samples

• support implementation of the F-10 Australian Curriculum
• examples of evidence of student learning in relation to the achievement standard
• assist teachers to make on-balance judgements about the quality of students’ achievement
• appreciate the progression of development

They contribute to ‘building teachers’ ability to assess against educational standards’ (OECD, 2013: 12).
Developmental progression and transfer

Long-term learning within a domain often involves the development of more sophisticated understandings of subject matter, increasingly deep knowledge (for example, a growing appreciation of the contexts to which knowledge can be transferred and applied), and a developing ability to apply understandings and knowledge in real-world contexts’ (Masters, 2013: 35)
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