Technology Curriculum Support

STRATEGIES FOR ENGAGING STUDENTS

This document provides a range of teaching strategies that can be included in the development of units of work to address specific student learning needs. These strategies have been identified by teachers and advisers as having the potential to enhance student understandings and practices about components of technology within *The New Zealand Curriculum (2007)*. The strategies presented have been organised into curriculum levels within each of the components of the three stands, with many of the ideas being applicable at multiple levels.

When selecting a strategy to include in a unit of work to address a specific student learning need, teachers are encouraged to look across the curriculum levels to identify strategies that best match the focused learning needs of their students and the context they have selected for learning in Technology.

It is intended that the range of strategies presented in these documents will be regularly updated. To enable this, we encourage teachers to provide feedback on the effectiveness of these strategies and to share any modifications or adaptations they made that improved student engagement and/or learning. Ideas for additional strategies which could be added to the documents within any particular component are also welcomed.

Please send feedback to Techlink@Techlink.org.nz

Cliff Harwood

Ministry of Education

Strategies for Engaging Students in Components of Technological Practice

Strategies for Engaging Students in Components of Nature of Technology

Strategies for Engaging Students in Components of Technological Knowledge

BRIEF DEVELOPMENT

The examples of teaching strategies listed below are shown against specific curriculum levels. Many of these strategies listed however are appropriate at multiple curriculum levels. When selecting a strategy to address a specific learning need(s) of students, teachers are encouraged to look across the curriculum levels to identify the strategy(ies) that best matches the focused learning needs of their students and the context they have selected for learning in technology. For example where the focus for next student learning is on getting students to 'justify' rather than just 'explain' their decisions then the teaching strategy adopted will need to allow a focus on improving student abilities to 'justify'.

BRIEF DEVELOPMENT: LEVEL 1

To support students to undertake brief development at Level 1, teachers could:
- provide the need or opportunity and develop the conceptual statement in negotiation with the students
- provide a range of attributes for discussion
- guide students to identify the attributes an appropriate outcome should have.

Indicators	Teaching Strategy	Explanation	Modifications/Reflections
Communicate the outcome to be produced	Literacy development – use describing words to explain existing products.	Have students describe existing products using terminology such as: light, heavy, shiny, red, plastic, paper etc.	
	Literacy development – use describing words to explain intended outcome, ie, what it is they're intending to produce.	Encourage students to describe their product(s) using terminology such as: light, heavy, shiny, red, plastic, paper etc.	
	Describe who will use their outcome, where it will be used, what it needs to do.	Use a template with stems for students to complete. For example… Outcomes will: • be used by .... • made from ..... • be used to	
Identify attributes for an outcome	Explain technological products.	Have students explain the attributes and uses for a range of known technological products. For example… Pencils are: • made from wood and lead • used to write and draw with.	
	Describe products from drawings.	From a picture of a known product, students are asked to describe its attributes: what it is made from; its colour; its shape; what it is used for; etc.	
	Use products students have used, seen and/or made before.	Through discussion and/or during story-writing time, students describe/record products they have used, seen and/or made before. These can be in a written format (by teacher) or visual format (by students). Provide a range of products.	
	Talk about a range of technological products in terms of their attributes.	Students are asked to talk about the products in terms of: what they do; what are used for, what they are made from; where they are used; etc.	

BRIEF DEVELOPMENT: LEVEL 2

To support students to undertake brief development at Level 2, teachers could:

- provide the need or opportunity and develop the conceptual statement in negotiation with the students
- guide students to discuss the implications of the need or opportunity and the conceptual statements and support them to establish a list of attributes an appropriate outcome could have
- provide students with an overview of the resources available and guide them to take this into account when identifying the attributes for the outcome.

Indicators	Teaching Strategy	Explanation	Modifications/Reflections
Explain the outcome to be produced	Explain a range of technological products in terms of: • the problem they resolve (what they do) • their attributes • where they are used.	Students explain a range of known and unknown technological products: • from their experience in interacting with them • through 'predicting' where they are used, who uses them etc.	
	Explain who will use their technological outcome, where it will be used, what it needs to do.	Students complete a template (graphic organiser) with stems . For example… Outcomes will: • be used to .... this will .... • be used by .... to .... • will enable/allow .... by	
Describe the attributes for an outcome that take account of the need or opportunity being addressed, and the resources available	Literacy development – use technical words to describe existing products.	Students describe existing products using terminology such as: plastic, attributes, wood, copper, stakeholders, gears, lever, screws.....	
	Literacy development – use describing words to explain intended outcome ie what it is they're intending to produce.	Encourage students to describe their product(s) using terminology such as: light, heavy, shiny, red, plastic, paper etc	
	Describing who will use their outcome, where it will be used, what it needs to do.	Encourage students to use technical terminology to describe the attributes of their outcomes. For example… Outcomes will: • be used by stakeholders who will….. • be made from 3mm diameter wire.... • be shiny to reflect ... • be oval in shape to	
	What are resources?	Discuss what resources are; the resources that will be used to develop an outcome. Teacher prepares a collection of physical resources (or photographs of resources) to support student responses.	

BRIEF DEVELOPMENT: LEVEL 3

To support students to undertake brief development at Level 3, teachers could:

- provide the need or opportunity and develop the conceptual statement in negotiation with the students
- guide students to describe the physical and functional nature of an outcome (for example, what it looks like and what it can do) taking into account the need or opportunity, conceptual statements and resources available
- guide students to identify the key attributes an appropriate outcome should have. Key attributes reflect those that are deemed essential for the successful function of the outcome.

Indicators	Teaching Strategy	Explanation	Modifications/Reflections
Describe the physical and functional nature of the outcome they are going to produce and explain how the outcome will have the ability to address the need or opportunity	Use key questions to describe the physical and functional nature of the intended outcome.	Questions to consider: • What will it be used for? • What will it look like? • What will it be made out of? • Where will it be used? • Who will use it? • Why am I making it? • What problem might this address?	
Describe attributes for the outcome and identify those which are key for the development and evaluation of an outcome	Matching descriptions of 'key' attributes to a range of products.	Students match a list of described 'key' attributes (eg, made from soft spongy material that is light weight) to a range of products that they are both familiar and unfamiliar with.	
	Describing 'key attributes', for their outcome.	Use a template with stems for students to complete. For example… The outcome: • will be used to… and needs to….. • looks like… • feels like ….	
	Matching key attributes to technological products.	Students match phrases that describe attributes of technological products to pictures of products. For example… • able to cut paper matched to scissors.	
	Using the 'key' attributes of given products, students identify what the product is/does.	For example… • This will be used by………………...to........ • This is made from …. so that it will .... • This must be able to.........so that ……….....	
	Students' evaluating the 'fitness for purpose' of products against given 'key' attributes.	Provide students with a list of key attributes that describe a product. Students asked to identify what the product is. What makes that product 'fit for purpose'?	
	Students using a set of given key attributes to evaluate the fitness for purpose of others products.	Students evaluate a range of products against a set of given 'key attributes' to determine their fitness for purpose. What makes that product 'fit for purpose'?	
	Literacy development – use of evaluative words.	Students evaluate another student's technological outcome against its brief, making suggestions for changes to 'key' attributes to allow an evaluation to occur where necessary.	
	Using a 'touchy/feely bag' where students cannot see the products inside.	Students describe attributes of products using terminology that enables others to know what: • the product is made from • the shape of product is • the product is used for. Students are asked to describe a range of products that they can physically touch but which are concealed within a bag, in terms of what they are feeling and smelling.	
	From given products attributes identify what the product is/does.	Provide students with a list of attributes that describe a product, asking them to identify what the product is.	
	Evaluation of the 'fitness for purpose' of products against given attributes.	Students evaluate a range of products against a set of given attributes to determine their 'fitness for purpose'.	

BRIEF DEVELOPMENT: LEVEL 4

To support students to undertake brief development at Level 4, teachers could:

- provide an appropriate context and issue that allows students to access resources (including key stakeholders)
- guide students to identify a need or opportunity and develop a conceptual statement
- support students to understand the physical and functional nature required of their outcome, and how the key attributes relate to this
- guide students to consider the key stakeholders and the environment where the outcome will be located.

Indicators	Teaching Strategy	Explanation	Modifications/Reflections
Identify a need or opportunity from the given context and issue .	Brainstorming needs or opportunities from a given context and/or situation.	On a given context and/or situation, the class brainstorms on a board/datashow/ smartboard to identify potential needs or opportunities, including identification of who their stakeholders would/may be.	
	Using a video of a natural or man-made (such as a building failure) disaster.	Students are asked to identify needs and/or opportunities for technological advancements/ solutions that would have alleviated the disaster occurring.	
	Personal contexts/issues.	Students are asked to examine personal contexts/ issues to generate needs or opportunities. For example… • Tramping = what needs/opportunities? • Messy bedroom = needs/ opportunities?	
Establish a conceptual statement that communicates the nature of the outcome and why such an outcome should be developed	Scaffolding student understanding by analysing conceptual statements.	Provide students with a range of conceptual statements that have been used to develop technological outcomes. Ask students to identify the 'key' information presented in the conceptual statements. For example… • Why is the need or opportunity able to be resolved/ fulfilled by the technological outcome? • Where is the outcome to be used? • Who will use it?	
	Writing conceptual statements that describe a technological opportunity.	Present students with a range of needs/opportunities and ask them to write a conceptual statement that would enable technological practice to be undertaken to address them.	
	Writing conceptual statements from existing technological practice.	Students are asked to write conceptual statements for issues/opportunities provided by teacher/identified from: • video clips of technological practice • Techlink resources (student examples or real technological practice case studies)	
Establish the key attributes for an outcome informed by stakeholder considerations	Use of mind maps to identify the 'key' attributes for a range selected products.	Students work in groups to identify key attributes and discuss these in order to justify those identified. • What might have been the stakeholder need(s) that led to the attributes? • Explain why these are deemed important to the stakeholder.	
	Stakeholder questions.	Students are helped to develop a series of questions that can be used to interview a person that will identify their need or opportunity. Technology student website (page 1) Technology student website (page 2)	
Communicate key attributes that allow an outcome to be evaluated as fit for purpose.	Identifying how key attributes may vary due to different uses of similar products.	Provide a range of products that perform similar functions and discuss how different attributes are prioritised because of their intended use/stakeholder needs. For example… • Hair cutting scissors must: be sharp, have needle pointed tips, be comfortable to use. • Craft scissors must: be able to cut cardboard, be blunt ended, have a plastic handle. Do these key attributes allow an outcome to be evaluated as fit for purpose?	

BRIEF DEVELOPMENT: LEVEL 5

To support students to undertake brief development at Level 5, teachers could:

- provide an appropriate context and issue that allows students to access resources (including key stakeholders)
- support students to identify a need or opportunity and develop a conceptual statement
- support students understand the physical and functional nature required of their outcome
- guide students to develop key attributes into specifications.

Indicators	Teaching Strategy	Explanation	Reflections
Identify a need or opportunity from the given context and issue	Brainstorming the needs and/or opportunities in a given context.	For a given context, the class brainstorms on a board/datashow/smartboard to identify potential needs or opportunities including identification of who the stakeholders would/may be. Develop a series of questions that can be used to interview a person that can help to identify a need or opportunity.	
	Use a video of a natural or man-made disaster.	After watching a video of a natural or man-made disaster, students identify needs and/or opportunities for a technological advancement/solution that could have prevented the disaster from occurring.	
	Personal contexts/issues	Students are asked to examine personal contexts/issues to generate needs or opportunities. For example… • Tramping = what needs/opportunities? • Messy bedroom = needs/ opportunities?	
Establish a conceptual statement that justifies the nature of the outcome and why such an outcome should be developed	Writing conceptual statements for given needs or opportunities	Students practice writing conceptual statements for an issue/opportunity that is provided by the teacher or identified from the above activities.	
	Students present their conceptual statement to class.	Students focus on justifying the nature of an outcome and explaining why such an outcome should be developed	
Establish the specifications for an outcome based on the nature of the outcome required to address the need or opportunity, and informed by key stakeholder considerations	Distinguishing the difference between attributes and specifications.	Provide students with a range of briefs that contain both attributes and specifications. In groups, students identify the attributes and the specifications.Examples of briefs can be found in Techlink Classroom Practice case studies, especially in the student workbooks.	
	Bulls-eye chart.	Three concentric circles – outside circle labeled attributes, middle circle 'key' attributes, inner circle specifications. Students to refine identified attributes into specifications (ie, measurable/observable functional and aesthetic expectations)	
	What? How? Why?	Students move from writing attributes to specifications, and then consider stakeholders in terms of: What?; How?; and Why?	
	Identify stakeholder considerations.	Students create a stakeholder profile, and write specifications that meet their need(s). See Technology student website – customer profile	
	Visiting technologists explain the practice they undertake to develop their brief (conceptual statements and specifications).	Students seek justifications from the technologists as to why they wrote the specifications they did into their brief (ie, why were they selected?)	
	Deconstructing an existing product to identify specifications.	Students write brief specifications for an existing product through deconstructing the product to identify such things as materials made from, cost, size of components/ingredients, relationships between components/ ingredients, safety considerations etc.	
	Presenting of a developed brief.	Students present their developed brief to their class, justifying why their selected specifications are important to address the need/opportunity.	
Communicate specifications that allow an outcome to be evaluated as fit for purpose.	Identify how specifications may vary due to different uses within similar products.	Provide a range of products that perform similar functions and discuss how different specifications were prioritised due to their intended use/stakeholder needs. For example… • Hair cutting scissors – are made from surgical quality stainless steel • Craft scissors – are made from carbon steel. Think, pair, share discussion that leads to a written example.	
	Critiquing specifications to determine their measurability or establish if they are observable.	Students sort a range of statements into those which are specifications and those which are not measurable/observable. • Identify what it is that enables a specification to be measurable? • Identify what it is that allows a specification to be observable? Note: an attribute is usually subjectively measured/determined, while a specification is more objectively measured/determined (ie, more specific)	

BRIEF DEVELOPMENT: LEVEL 6

To support students to undertake brief development at Level 6, teachers could:

- provide an appropriate context and issue that allows students to access resources (including key stakeholders) and guide them to take into account wider community considerations
- support students to identify a need or opportunity relevant to the given issue and context
- support students to understand the physical and functional nature required of their outcome
- support students to develop specifications and justify them based on key and wider community stakeholder considerations.

Indicators	Teaching Strategy	Explanation	Reflections
Identify a need or opportunity from the given context and issue	Understanding the differences between a context, issue, need and opportunity.	Scaffold students' understanding through activities such as: • First definition/second definition • Place mat Use teacher-provided examples and the Connected series for examples (see Curriculum Support Material, page 11).	
	Identifying an issue, need or opportunity from a video or case study that describes a context.	Provide students with a range of videos or case studies and have them determine an issue, needs or opportunity. For examples of activities refer to the book Top Tools for Social Sciences Teachers.	
	Reviewing the technological practice undertaken by a technologist.	Students identify a potential issue, need or opportunity and provide justifications as to why they believe these are relevant to the context. Use case studies, videos, and/or visits to a practicing technologist to observe their practice.	
	Developing questions to identify the issue, need or opportunity.	Provide a context to students and ask them to structure questions that will identify an issue, need or opportunity. This will also promote students skills in questioning techniques. Questions can go onto a dice template and used by them and/or other students in the future.	
	Potential client presenting their context.	A client (real or role play) presents a context and/or issue. Students question the client to gain more information. Based upon presentation and questioning the client, the students identify a need or opportunity. This can include the identification of key stakeholders. Encourage students to provide justifications as to why they believe these are relevant to the context.	
Establish a conceptual statement that justifies the nature of the outcome and why such an outcome should be developed	Using a technologist to critique student conceptual statement.	Technologist critiques student conceptual statements once developed. Students critique a technologist's conceptual statement.	
Establish the specifications for an outcome as based on the nature of the outcome required to address the need or opportunity, consideration of the environment in which the outcome will be situated and resources available	Analysis of brief developed by practicing technologists.	Use briefs that evolved as the outcome progresses towards a technological outcome. For example… • client specifications to architect • architect specifications to builder Ask students to identify: • how specifications change according to their intended audience but that, in changing, they are making clearer the justification for and needs of the outcome • the constraints imposed by the brief on the outcome and the practice undertaken for its realisation. Ask students to determine the specifications that focus on the outcome and those that are concerned with the practice undertaken to realise the outcome.	
Communicate specifications that allow an outcome to be evaluated as fit for purpose.	Key stakeholders critique specifications to determine if they will enable an outcome to be evaluated as fit for purpose.	Key stakeholders informed to ensure that they understand the difference between a specification and an attribute	
Justify the specifications in terms of key and wider community stakeholder considerations.	Analyse the physical and social environment in which a technological outcome will be located - include feedback from key and wider community stakeholders	Use evaluation tools such as : • CAMPER (consequences, actions, minimisations etc) • SWOT/SWOB analysis	

BRIEF DEVELOPMENT: LEVEL 7

To support students to undertake brief development at Level 7, teachers could:

- provide a context that offers a range of issues for students to explore
- guide students to select an authentic issue within the context. An authentic issue is one which is connected to the context, and allows students to develop a brief for a need or opportunity that can be managed within the boundaries of their available resources.
- support students to identify a need or opportunity relevant to the issue
- support students to understand the physical and functional nature required of their outcome
- support students to justify the nature of their outcome in terms of the issue it is addressing
- support students to develop specifications and provide justifications for them drawing from stakeholder feedback, and wider community considerations such as the resources available to develop the outcome, ongoing maintenance of the outcome once implemented, sustainability of resources used to develop the outcome and the outcome itself, disposal of the developed outcome when past its use-by date.

Indicators	Teaching Strategy	Explanation
Explore the context to select an issue	Use a range of evaluative tools to explore and evaluate a context.	Evaluation tools could include: PMI ; CAMPER (consequences, actions, minimisations) ; SWOT/ SWOB analysis; Waterfall questions; 'What if…' questions; Ryan's Thinkers Keys; Evaluating dice – with key questions; Question box – with key questions (colour coded for different levels), see Bloom's Taxonomy.
	Exploring contexts and issues.	Provide students with a variety of scenarios (contexts) which they can critically evaluate to identify issues that allow for the undertaking of technological practice to derive a feasible outcome.Students undertake feasibility studies on the issue(s) and the likely technological practice that is required to resolve the issue(s).
Identify a need or opportunity relevant to their selected issue		Expand on examples listed in Level 6.
Establish a conceptual statement that justifies the nature of the outcome and why such an outcome should be developed with reference to the issue it is addressing	Literacy development – using linking words to provide justifications.	Encourage students to use linking language, such as: as a result of…; because…; therefore…
	Student (and/or practicing technologist) critique students' developed conceptual statements.	Students (and/or practicing technologists) critically analyse each other's (student) developed conceptual statements to ensure that it is robust and can be justified. How will the conceptual statement allow the issue to be addressed?
Establish the specifications for an outcome using stakeholder feedback, and based on the nature of the outcome required to address the need or opportunity, consideration of the environment in which the outcome will be situated, and resources available	Strategies for eliciting stakeholder feedback.	Students explore the advantages and limitations of strategies such as: • surveys • email, social networking sites • interview – face-to-face, phone, Skype to obtain feedback from key and wider community stakeholders.
	Specification checklist.	Do the specifications consider… • stakeholder feedback? • the nature of the outcome? • the need/opportunity? • the environment where the technological outcome will be developed? • the environment where the technological outcome will be placed? • the resources required to develop a technological outcome and demonstrate its fitness for purpose?
Communicate specifications that allow an outcome to be evaluated as fit for purpose	Students in pairs clarifying their specifications.	Students share their specifications with a partner. • Are the specifications explicit enough to be used to evaluate the fitness for purpose of a developed outcome?
Justify the specifications in terms of stakeholder feedback, and the nature of the outcome required to address the need or opportunity, consideration of the environment in which the outcome will be situated, and resources available.	Literacy development – use linking words to provide justifications.	Encourage students to use linking language such as: as a result of… ; because… ; therefore…; henceforth…; consequently…
	Another student (and/or practicing technologist) critique a students developed specifications.	Another student and/or a practicing technologist critically analyses a student's specifications to verify if they can be justified and enable a technological outcome to be determined as fit for purpose. Focus on answering questions such as: • How do the specifications address the need or opportunity? • Has the students specifications considered stakeholder feedback? • Has the environment where the outcome will be developed been considered? • Has the outcome's intended environment been considered? • Do the specifications consider available resources?

BRIEF DEVELOPMENT: LEVEL 8

To support students to undertake brief development at Level 8, teachers could:

- support students to identify a context that offers a range of issues for them to explore
- support students to select an authentic issue within their selected context
- support students to identify a need or opportunity relevant to the issue and context
- support students to understand the physical and functional nature required of their outcome
- support students to justify the nature of their outcome in terms of the issue and context
- support students to develop and justify specifications that will allow the evaluation of the outcome and its development to be judged as fit for purpose in the broadest sense. Fitness for purpose in its broadest sense refers to the 'fitness' of the outcome itself as well as the practices used to develop the outcome (for example, such things as the sustainability of resources used, ethical nature of testing practices, cultural appropriateness of trialing procedures, determination of lifecycle and ultimate disposal

Indicators	Teaching Strategy	Explanation
Identify and evaluate a range of contexts to select an authentic issue	Use student exemplars and case studies of technologists practice.	Analyse previous students' technological practice/case studies to identify the critical evaluation that occurred to determine a suitable context and issue to undertake technological practice. Questions that could be answered by students include: • What implications did the selected context impose on the technological practice undertaken to develop the technological outcome, who initiated these and who (stakeholders) were the beneficiaries/losers? • What consequences resulted due to implementing the technological outcome? • What was prioritised in developing and implementing the outcome?
	Use of compare and contrast templates (such as a Venn Diagram).	Exercises in comparing and contrasting such things as: • contexts • technological outcome • technological practice undertaken and specific parts of practice, such as stakeholder interactions, technological modelling, planning techniques etc.
	Identify suitable clients from possible issues.	Provide scenarios of potential client issues and ask students to critically evaluate clients and issues to determine their suitability for engagement. Justifications are required to support their inclusion or rejection as potential clients.
	Developing questions to determine client suitability.	The class brainstorms to identify questions that will elicit information that will determine if a client is potentially suitable. For example… • Is the client providing an opportunity to undertake technological practice to resolve an issue? • Can a technological outcome be realised within the time constraints and using the available resources?
Identify a need or opportunity relevant to their selected issue	Relevance of need/opportunity to the issue.	Students present their need/opportunities to the class. Class critiques the need/ opportunities relevance to the selected issue.
Establish a conceptual statement that justifies the nature of the outcome and why such an outcome should be developed with reference to the issue being addressed and the wider context		Expand on examples listed in Level 7
	What is the wider context?	A wider context is…
Establish the specifications for an outcome and its development using stakeholder feedback and based on the nature of the outcome required to address the need or opportunity, consideration of the environment in which the outcome will be situated, and resources available		Expand on examples listed in Level 7
Communicate specifications that allow an outcome to be evaluated as fit for purpose in the broadest sense	Students critique a range of practicing technologist briefs.	Students critically analyse the technological practice undertaken by a range of practicing technologists to develop a brief, to identify if their specifications are robust and allow a developed technological outcome to be evaluated as 'fit for purpose'. Select a range of technologists – for example, an architect, a product designer, a graphic designer, an engineer, a food technologist etc.
Justify the specifications as based on stakeholder feedback and the nature of the outcome required to address the need or opportunity, consideration of the environment in which the outcome will be situated, and resources available		Expand on examples listed in Level 7

PLANNING FOR PRACTICE

The examples of teaching strategies below are shown against specific curriculum levels. When planning a technology unit however the specific teaching strategy selected will depend on the context learning. Teachers are therefore encouraged to look across the curriculum levels to identify strategies that best match the focused teaching needs of their students and the context selected for learning. Teachers also need to be aware of cultural considerations and include appropriate strategies for Maori and Pasifika students. Examples of these strategies can be found in resources such as Tuakana Teina

PLANNING FOR PRACTICE: LEVEL 1

To support students to undertake planning for practice at Level 1, teachers could:

- ensure that there is a brief against which planning to develop an outcome can occur
- provide students with a detailed plan of what they will be doing during their technological practice. This could be presented and explained as a design process the teacher has developed, with key stages that need to happen clearly identified within it
- provide a range of appropriate resources for students to select those suitable for their use. Teachers should ensure all resources provided are appropriate for use and students should only be responsible for selecting particular materials components, and/or software from these resources.

Indicators	Teaching Strategy	Explanation
Identify what they will do next	Class brainstorms to identify the technological practice that is required when developing a technological outcome.	Refer to students' prior technological practice experiences to draw out what should happen next.
	Take photos of key stages of a familiar process and getting students to organise them in to order.	Have students order the photos so that the key stages are in the sequence in which they were undertaken (either for their own practice and/or an observed practice of someone else).
	Use photos or images of the resources students have used in the past to undertake a process/ practice.	Have students order the photos so that the resources are in the sequence in which the process/practice took place.
	Structured reflection across all aspects of the practice students undertook to develop a technological outcome.	Have students describe or draw pictures to explain the practice they undertook and the resources they used in this practice.
	Flow chart template with broad categories of the steps to go through to produce a technological outcome.	Students to complete the template describing and drawing each step of the practice that could be undertaken. Extension: Have some steps missing in the practice and ask students to identify what the step is that is missing and what needs to occur here within the practice.
	Deconstruct activity of a process that students are familiar with, for example, putting shoes on, making toast.	Students draw and explain the steps required to complete the process on a flow chart template.
	Think, Pair, Share activity to describe the parts of the process they might go through to develop a technological outcome.	Think individually about the steps in the process – moving around class/group, have each student give an idea and receive one back from someone else in the class/group.
	Give One, Get One activity to describe the 'next' key stage in the process they need to go through to develop an outcome.	Students take turns in providing the 'next' key stage in the process they need to go through to develop an outcome.
Identify the particular materials, components and/or software they might use.	Photos of the resources (materials, components and/or software) and/or samples of the resources students could possibly use to develop an outcome.	Students to: • select the resources in the order they would use them to develop their outcome • explain why they have selected them for use in this order.
	Flow chart template with the steps identified to produce a technological outcome.	Students complete the template by describing and drawing the resources required to complete each step. Extension: Have some steps missing in the practice and ask students to identify the missing steps and the resources required to complete the practice.
	Identify the resources which are the Odd One Out for developing a technological outcome.	Provide students with a technological outcome and a range of resources. Get them to describe which resources are the odd ones out (ie, those that are not appropriate/needed to develop the technological outcome.
	Resource Grouping.	Using pictures of resources, students group them according to the key stages they would follow to undertake their practice to develop an outcome.

PLANNING FOR PRACTICE: LEVEL 2

To support students to undertake planning for practice at Level 2, teachers could:

- ensure that there is a brief against which planning to develop an outcome can occur
- provide students with an overview of the stages they will be working through during their technological practice. This could be presented and explained as a design process the teacher has developed, and it could be used to support students to identify what the key stages are
- provide a range of appropriate resources and guide students to decide which particular materials components, and/or software will be required for each key stage. Teachers should ensure all resources provided are appropriate for use.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Identify key stages required to produce an outcome	Game Play – "What comes next?"	Give students a set of photographs of a sequence of steps undertaken to develop a technological outcome, with steps missing at the end. Students to suggest either next possible step and/or what the finished outcome would/could be. Repeat the activity but with a key step(s) missing in the middle of the sequence and have student determine what the missing key step is.	
	Students in pairs use dice with questions that require student answers.	Use teacher-created dice with questions specific to the teaching programme or get students to create their own questions for each other. Example questions... • What key stages have I done so far? • What key stages do I still need to do? • What resources have I used so far? • What resources will I need next?	
	Record answers on a template and peer critique using a bank of guided questions.	Use a range of known and unknown technological products so that students can explain them: • from their experience in interacting with them • through 'predicting' what they are used for, where they are used, and who uses them, • through the steps undertaken to make them, etc. Use a template with stems for students to complete For example…. Outcomes are: • used to .... This will .... • used by .... to .... • made by .... using • made using the following steps	
	Buddy chat – in pairs, students describe what they have done to-date and what needs to be done next.	Encourage students to listen and ask questions such as: • Why did you do this? • How did it help you? • What will you do next? • What resources will you need?	
Identify the particular materials, components and/or software required for each key stage	Students complete a template to record from a bank of resources (pictures and/ or actual resources) those that they think they will need for each key stage to produce a technological outcome to meet required attributes.	Provide a range of pictures of and/or actual resources for students to see and interact with. Have them determine the resources they will need at each key stage.	
	Flow chart template with the key stages identified to produce a technological outcome.	Students to complete the template by describing and drawing the resources required to complete each key stage. Extension: Have some key stages missing in the practice and ask students to identify what the stage is that is missing and the resources that are required to complete it.	

PLANNING FOR PRACTICE: LEVEL 3

To support students to undertake planning for practice at Level 3, teachers could:

- ensure that there is a brief against which planning to develop an outcome can occur
- provide students with an overview of what they will need to do during their technological practice and guide students to identify key stages and place these on a timeline of some sort
- provide resources including a range of appropriate materials, components, software, hardware, equipment, and/or tools for students to select from and guide students to select those that will be suitable for their outcome
- guide students to reflect on progress to make informed decisions regarding next steps.

Indicators	Teaching Strategy	Explanation	Reflection
Identify key stages, and resources required, and record when each stage will need to be completed to make sure an outcome is completed	Identify key stages in someone else's technological practice.	Provide students with a description (video, photos and/or incomplete flow chart) of the key stages of technological practice used to develop a technological outcome. Students to: • identify the key stages and sequence that occurred (video) • order these into the sequence that would enable the technological outcome to be developed (photos) • identify the next key stages to complete the technological outcome (incomplete flow chart) Students explain the consequences if a particular key stage was not undertaken within the practice used to develop the technological outcome and/or if a resource was not used. Buddy chat – students talk/discuss in pairs.	
	Students create a flowchart of the key stages and the resources required at each stage of their own technological practice and/or that of someone else.	The teacher creates the initial flowchart identifying some of the key stages and resources required, leaving space for students to add further stages and resources as they plan to undertake their own technological practice and/or to enable someone else's practice to be completed.	
	Video clip(s) of the technological practice used to develop a technological outcome.	Deconstruct the practice that was used to develop the technological outcome. Identify the key stages followed and the resources that were used – record on a flow chart template.	
	Review photos of other student's previous technological practice and identify the key stages they followed.	Identify the resources that were used and record these on blank cards beside the appropriate photos. Sequence the photos and resources in the order that they would have occurred within technological practice. Note: this can be used a class planning tool that is placed on the wall to inform students in their own undertaking of technological practice.	
	Students to complete a key stages timeline for the technological practice they undertook to develop a previous technological outcome.	Alongside this timeline record the practice they intend to follow to develop their next technological outcome.	
	Students in pairs use dice with questions to identify what they need to consider.	Use teacher-created dice with questions that are specific to the teaching programme or get students to create their own questions for each other. Example questions: • What key stages have I done so far? • What key stages do I still need to do? • How have my key stages changed? • How can I manage my time better? • What changes have I made to my outcome / planning? • What resources have I used so far? • What resources will I need next? • How can I manage my resources better? • People resources; Who can help me?	
	Students asked to compare the resources they used for a previous practice that was used to develop a technological outcome with their current practice.	Students to focus on identifying similarities and differences (use a Venn diagram to illustrate the similarities and differences).	

Explain progress to date in terms of meeting key stages and use of resources, and discuss implications for what they need to do next.	Class/group brainstorm (GANTT charts) to consider next key stage and the resources necessary to complete it in terms of time, tools, materials, people.	Teacher provides a GANTT chart template and guides students through the process of completing it.	
	Students recording differences between their practice and that illustrated on a class developed GANTT chart.	Using a class-developed GANTT chart, students record any changes (and explain reasons for these changes) according to the technological practice they undertook to develop a technological outcome.	
	Group discussion/decision making session(s) to consider and agree on a way forward (next key stage and resources required) when developing a technological outcome.	Students to present to group/class what they have done to date and seek feedback on the best way forward in terms of the next key stage and resources required develop their outcome.	
	Students provided with a complete list of the resources that could be used to develop a technological outcome that addresses a need or opportunity. Students invited to remove those resources not crucial to the development of their outcome.	From the available resources students/groups choose the resources they will use (ingredients, utensils etc.) and produce an outcome that addresses the directed brief. Once outcome completed, class discusses: • What were the key resources used to produce the outcome? • How did those used differ between students/groups? • How do the outcomes themselves differ between students/groups due to the different resources used?	
	Who needs what and how to manage it matching game.	Student A writes the resources they predict they will need, on separate pieces of paper, for each key stage of the technological practice they intend to undertake to develop an outcome. The pieces of paper are then shuffled up so that they are out of order. Student B is then required to sort the pieces of paper into the order that the resources will need to be used.	

PLANNING FOR PRACTICE: LEVEL 4

To support students to undertake planning for practice at Level 4, teachers could:

- ensure that there is a brief against which planning to develop an outcome can occur
- provide resources including a range of appropriate stakeholders, materials, components, software, hardware, equipment, and/or tools for students to select from and support students to select those that will be suitable for their outcome
- provide planning tools and support students to use these to record key stages and resources needed, including when they will need to access stakeholder feedback – records only need to capture what students plan to do and when they need to do it to guide their practice and should be reviewed regularly
- support students to identify regular review points and to review their progress at these points
- guide students to manage time and organise their selected resources .based on regular reviews of progress

Indicators	Teaching Strategy	Explanation
Use planning tools to manage time, identify and record key stages, associated resources, and actions to be undertaken, with progress review points clearly indicated	In groups students revisit a previous planning tool they have used and discuss the usefulness of this tool as a means of recording and informing the practice that was undertaken.	Encourage students to reflect on such things as the actual time it took to complete each key stage of the practice, how useful the planning was in informing the next stage of practice etc.
	Look at a selection of planning tools used by others (senior students) to see the similarities and differences between them.	Students to identify: • the similarities and differences between the planning tools used, • where within the practice they were used • how the planning tool(s) were used to inform the practice undertaken.
Review progress at set review points, and revise time management as appropriate to ensure completion of an outcome.	Use planning tool(s) to plan overall practice and structure key stages, base this planning on knowledge gained from undertaking previous planning actions.	Students encouraged to reflect on the tools that worked well and those that didn't from their previous planning practice. Students use understandings gained to inform selection of planning tools for next practice.
	Class discussion on the most appropriate planning tools for different aspects of current practice.	Focus discussion on identifying those tools most suitable for: • initial planning of intended key stages, • planning for resource management and activities within identified key stages • planning for outcome testing and evaluation etc.
	Strategies for gaining quality stakeholder feedback.	Review the practice of others (senior students and/or practicing technologists) to identify the planning strategies/tools that were used to obtain stakeholder feedback. Analyse these to identify if they allowed quality feedback to be received.
	Group discussion to consider and agree on best strategy(ies) for obtaining stakeholder feedback and most appropriate tool(s) for analysing this feedback.	Students to present to group/class the strategy(ies) they are considering using to obtain stakeholder feedback. Discussion should focus on the merits of the strategy, identifying likely responses and therefore the appropriate tool for analysing the feedback.
	Analyse the practice of others to identify how they planned ahead, including how they managed time and documented their practice.	Use case studies off the Techlink website of previous students practice and/or the practices of practicing technologists.
	Teacher questioning students/groups about the list of resources they have identified as needing in order to undertake technological practice to develop a technological outcome, the next set of key stages and how time will be managed.	Question students/groups about their identified resources in terms of: • when (what stage of their practice) they will require the resource(s) • if they have the appropriate level of knowledge and skill to use the resource and if not how they will access it • if the resource identified is the most appropriate to complete this key stage of their practice • what will happen to the resources once the key stage is finished, etc. • how much time is required to complete a stage • implications of time taken to complete a stage in the overall management of the time allowed to develop the technological outcome.
	Students to sequence photos of someone else's (senior students and/or a practicing technologists) technological practice that was undertaken to develop a technological outcome. Note: Each photo represents a key stage in the development of the technological outcome.	Beside each photo students to identify the: • resources that where necessary to enable the stage to be completed • aspects that needed management; for example, safety, storage, resources requiring handling in a specific way, disposal of waste etc. • likely time required to complete each stage • likely overall time taken to complete the technological outcome.

PLANNING FOR PRACTICE: LEVEL 5

To support students to undertake planning for practice at Level 5, teachers could:

- ensure that there is a brief against which planning to develop an outcome can occur
- provide a range of planning tools and support students to analyse these to inform selection of the tools they will use to manage and efficiently record their planning
- support students to review and evaluate progress to inform their ongoing planning decisions
- guide students to ensure appropriate resources are available (stakeholder/s, materials, components, software, equipment, tools and/or hardware) suitable for their outcome
- support students to manage time and resources, including stakeholders interactions.

Indicators	Teaching Strategy	Explanation	Reflection
Analyse own and others use of planning tools to inform the selection of tools best suited for their use to plan and monitor progress and record key decisions.	Revisit a previous planning tool students have used and discuss the usefulness of this tool to record the practice undertaken.	Students to reflect on such things as the actual time taken to complete each key stages of the practice, how useful the planning was in informing next stage etc.	
	Look at a professional technologists practice to identify the planning tools they used (may have used).	Using an existing a product and known technologists practice (where available) explain (predict): • What planning tools were used? • What were their key stages? • What actions did they undertake at each of the key stages? • How did they review their progress? • What informed changes to their planning? • How did they identify their resources and then manage them? Fun examples... • www.dinosaurdesigns.com • www.davidtrubridge.com • www.huffer.co.nz • www.threadless.com • www.gadgetnation.net • www.loyalloot.com • www.farmdesigns.co.uk • www.shin.co.nr	
	Analyse a selection of planning tools used by others (senior students and/ or practicing technologists) to see the consistencies and differences between them.	Students to identify: • similarities and differences between the planning tools used • where within the practice they were used • how the tool(s) were used to inform the practice undertaken.	
	In pairs or groups, using a new and unrelated brief, each pair/group has a different planning tool.	Discuss and justify, within the context of the specific brief: • Will the planning tool allow the brief to be addressed (issue resolved)? • Why/why not? • What modifications that could be made to the planning tool to enable the brief to be addressed When complete, ask the rest of class to critique their justifications.	
	Progress review points/ managing resources trials.	Split class into groups, all groups to create an outcome (such as origami) using technological practice within one lesson. Some groups have insufficient resources/time/people. Group A has only one final review point. Group B has maybe two progress review points. Group C have several progress review points. Some progress review points that they have are however purposefully placed in the wrong places. Students discuss and reflect on the outcomes achieved by each group and what assisted/hindered the attaining a quality outcome.	

Use planning tools to identify and record key stages, and manage time and resources (including stakeholder interactions) to ensure completion of an outcome	Discussion on the most appropriate planning tool for different aspects of practice.	Class discuss the most appropriate planning tools for different aspects of practice. For example – What planning tools are most suitable for: • initially planning intended key stages? • planning for resource management? • planning for activities within an identified key stage etc? • materials flows?	
	Teacher-led example of how to use planning tools to plan overall practice, structure key stages, and manage time and resources.	Base this planning on knowledge gained from undertaking previous planning actions. Students encouraged to reflect on and discuss what worked well and what didn't for their previous planning practice. Encourage students to use 'linking words in their discussions such as: • ...because... • ....and therefore ..... Use understandings developed from this activity to inform next planning.	
	Oral justification.	Student(s) explain to the rest of the class why they are using the planning tools they are (suggest one student per session). Explain such things as: • why they selected the planning tool(s)? Advantages/Disadvantages they have found in using them • how the planning tool assists them in justifying the decisions they made • how the planning tool enabled them to manage time and resources effectively/efficiently. Encourage other students to question the presenting student in order to find out about different tools used.	
	Photos of different stages of the development of a technological outcome compared to available planning tools.	Provide students with a selection of photos of different stages of the development of a technological outcome. For example stages could be: mixing and blending of ingredients for a muffin, identifying type/style of garment suitable to be worn at an identified special event. Also supply them with a range of planning tools. Have students match the outcome/stage onto an appropriate planning tool and justify their choice. Teacher questioning will ensure deeper thinking through using Three-storey intellect or Blooms Taxonomies.	
	Create dice with focus questions.	Students create the questions that will focus them and others to ensure their justifications are appropriate, by referring to statements such as: • Planning decisions made ... • Planning tools selected ... • Planning tools dismissed ... • Time taken to complete ... • Resources used to complete .... • Altered practice chosen ... • Modifications to outcome ... The dice can then be used when planning to encourage students to reflect on their planning decisions.	
Use planning tools to record key planning decisions regarding the management of time, resources and stakeholder interactions	Teacher questioning students about the list of resources they will need to organise in order to undertake technological practice to develop an outcome and the time it will take to complete each key stage.	Question students about such things as: • What are the key stages required to develop their outcome? • The appropriateness of the identified resources for each key stage. • How will they manage the resources during their practice to maximise efficiency of practice and achieve the desired outcome • When will they need to access the resource(s) for each stage • What will happen to the resource(s) once the key stage is finished, etc? • What time has been allowed for each key stage?	
	Photos of different stages of the development of a technological outcome.	Provide students with a selection of photos of different stages of the development of a technological outcome. For example stages could be: mixing and blending of ingredients for a muffin, identifying type/style of garment suitable to be worn at an identified special event. Also supply them with a range of planning tools. Have students match the outcome/stage onto an appropriate planning tool and record time allowed, resources and stakeholder interactions that would need to occur to complete each stage.	

PLANNING FOR PRACTICE: LEVEL 6

To support students to undertake planning for practice at Level 6, teachers could:

- ensure that there is a brief against which planning to develop an outcome can occur
- support students to critically analyse a range of planning tools that have been used in past practice
- support students to select planning tools that will provide appropriate support for their practice and efficient recording of why key planning decisions were made
- support students to ensure appropriate resources are available (stakeholder/s, materials, components, software, equipment, tools and/or hardware) suitable for their outcome
- support students to use selected tools to manage resources to ensure completion of an outcome.

Indicators	Teaching Strategy	Explanation	Reflection
Critically analyse own and others use of planning tools to inform the selection of planning tools best suited for their use to plan and monitor progress and record reasons for planning decisions	What does critical analysis mean?	Students develop questions that enable them to critically analyse a technological outcome (or a photo of an outcome) in regard to a specific functions/attributes (such as ergonomics, fitness for purpose). Focus students on creating 'fertile' questions that allow a critical analysis to be undertaken.	
		Now move to critical analysis of planning practices. Model this with a case study of someone else's technological practice, including their use of planning tools. Start with a past/present student's work or a Techlink Student Showcase (www.techlink.org.nz/student-showcase). What planning practices did/might they have been used? Then move on to Techlink Classroom Practice case studies (www.techlink.org.nz/Case-studies/Classroom-practice), and then use a Techlink Technologists' Practice case study. Use these points as a class to create focussed questions in which to approach the critical analysis of a case study... • What overall planning and project management tools were used? • How did these tools ensure fitness for purpose of their (own) outcome? • What strategies were used to gain access to stakeholder feedback? • What resource management techniques were used and how were these planned for? Students add to this list of focus questions.	
	Students critically analyse own past planning and organisational practice.	(Ideally the above activity is to be done first) Students critically evaluate their own practice focusing on such things as: • their overall planning and project management • how they ensure that their outcome would be fit for purpose • strategies they used for gaining access to stakeholder feedback • resource management techniques used and how this was planned for.	
Use planning tools to establish and review keys tasks, identify and manage all resources, and to determine and guide actions to ensure completion of an outcome	Use of physical and virtual (modelling) planning tools.	Students are encouraged to use a range of different physical and/or virtual planning tools. Students discuss pros and cons of each and determine their effectiveness in informing ongoing practice. • What issues were identified in their use? • How can these risks minimised/eliminated to ensure the successful completion of their outcome • Were there better tools that could have been used at different stages within the practice?	
	Identify the strengths and weaknesses of different planning tools.	Focus on answering questions such as: • What is the planning tool and how is it best used? • What is the likely information the planning tool will elicit when used in practice? • What key stage within practice is this planning tool most suited to in terms of providing informed projections • What impact is the information gained through the use of this tool likely to have on future practice • How much iteration is necessary between the planning tool and the ongoing development of the technological outcome to ensure the outcome(s) developed is fit for purpose?	

Use planning tools to record initial plans and ongoing revisions in ways which provide reasons for planning decisions made	Explore contexts and issues.	Provide students with a variety of scenarios (contexts) which they can critically evaluate to identify issues that provide opportunity for the undertaking of technological practice. Students undertake feasibility studies on these issues and determine the likely technological practice and key stages required to develop an outcome that addresses the issue.	
	Literacy development – using linking words to provide justifications.	Encourage students to use linking language when justifying aspects of their planning practice. Such words could include: • as a result of... • because... • therefore ... Refer to Effective Literacy strategies book for Secondary Schools.	
	Model justifications.	Students to formulate 'model justifications' (explanations) that draw off each students previous planning decisions	
	Explore the use of a range of evaluative tools.	Evaluation tools could include: • PMI • CAMPER (consequences, actions, minify /modify/magnify, put into another use, eliminate, reverse) • SWOT/SWOB analysis • 'What if...' questions • Ryan's thinkers keys • Evaluating dice – with key questions • Question Box – with key questions (colour code for different levels) see Blooms taxonomy. What are the advantages / disadvantages of these tools? When would you use each tool?	
	Justifying the management of resources in terms of the physical and social environment in which they are used.	Students to critically evaluate: • the practice of others (case study and/or observation of a practicing technologists practice) to determine how well they managed resources within the physical and environmental location in which they were used. • their own past practice to determine how well they managed resources within the physical and environmental location in which they used.	

PLANNING FOR PRACTICE: LEVEL 7

To support students to undertake planning for practice at Level 7, teachers could:

- ensure that there is a brief against which planning to develop an outcome can occur
- support students to critically analyse a range of planning tools and project management practices that have been used in past technological practice
- support students to select and use planning tools to make effective planning decisions and establish and manage all resources (including time, money, stakeholder/s, materials, components, software, equipment, tools and/or hardware etc). Effective planning decisions enable the outcome produced to successfully meet the brief.
- support students to select and use planning tools which will allow for the efficient recording of justifications for key planning decisions made.
- support students to ensure appropriate resources are available (stakeholder/s, materials, components, software, equipment, tools and/or hardware) suitable for their outcome.

Indicators	Teaching Strategy	Explanation
Critically analyse existing planning tools and project management practices to inform the selection of planning tools appropriate for the technological practice to be undertaken, and for recording evidence to support any revisions to planning	Critically analyse others (practicing technologist and/or student) project management practices through evaluation of case studies and/or their actual practice as observed/presented.	Critically evaluate the practice of others focusing on such things as: • the planning and project management tools they used • the planning they undertook to enable the fitness for purpose of the outcome developed to be verified • the management practices they used to ensure valid stakeholder feedback was accessed • the planning tools they used to manage the efficient use of resources Include in this critical analysis a comparison with the student's own practice
	Flowchart a practicing technologist's or other students past planning practice and critically analyse it to inform own planning practice.	Flow chart showing... • What the analysis of a technologists planning practice told them • Implications/findings/what I learnt • How I will/did use understandings gained from this analysis to inform my own planning practice.
	Develop planning practices... Use roles in group situations – either the real project or a simulated one-off.	Each student has a different role, such as: project manager; resource manager; time keeper; researcher; construction manager. Answer questions such as: • What personal qualities does each role require? • How successful was each student in fulfilling their role? • What part does each role play in the overall success of the technological practice undertaken? Have students reflect on how these roles are accounted for/undertaken in their own planning practice, when developing technological outcomes?
Use planning tools to set achievable goals, manage all resources, plan critical review points, and revise goal and resources as necessary to ensure the effective completion of an outcome	Look the use of planning tools and determine the likely accuracy/validity of projections made based on findings obtained from them.	Focus on identifying the strengths and weaknesses of each planning tool in terms of allowing accurate and valid projections to future practice required to be made.
	Use of physical and virtual planning tools, and project management practices.	Focus on encouraging students to project and substantiate their judgments about the success or otherwise of the expected outcome(s) when they are placed in their intended physical and social environment, using physical and/or virtual planning tools.
Use planning tools to provide evidence for any revisions made at critical review points and justifies the appropriateness of planning tools used.	Explore the use of a range of evaluative tools.	Evaluation tools could include: PMI; CAMPER (consequences, actions, minify / modify/magnify, put into another use, eliminate, reverse); SWOT/SWOB analysis; 'What if…' questions; Ryan's Thinkers Keys; evaluating dice with key questions; Question Box – with key questions (colour code for different levels) see Blooms Taxonomy.
	Literacy development – using linking words to provide justifications.	Encourage students to use linking language such as: • as a result of • because • therefore ..... Refer to Effective Literacy Strategies book for Secondary Schools for further examples.
	Justifying the management of resources in terms of the physical and social environment in which they are used.	Students critically evaluate: • the practice of others (case study and/or observation of a practicing technologists practice) to determine how well they managed resources within the physical and environmental location in which they used. – if their management practices made an impact on the sustainability of the resources used and the outcome itself • their own past practice to determine how well they managed the resources within the physical and environmental location in which they used.

PLANNING FOR PRACTICE: LEVEL 8

To support students to undertake planning for practice at Level 8, teachers could:

- ensure that there is a brief against which planning to develop an outcome can occur
- support students to critically analyse a range of project management practices and explore how project scheduling is used to manage technological practice
- support students to establish and implement a coherent project schedule that allows for the coordination and management of the: regular review of goals, planning tools, all resources required (time, money, stakeholder/s, materials, components, software, equipment, tools and/or hardware etc) and review points
- support students to provide evidence of effective and efficient planning decisions – effective and efficient planning decisions ensures that the use of resources is optimised during the development and production of an outcome produced to successfully meet the brief.

Focused Learning	Teaching Strategy	Explanation	Reflection
Establish a coherent project schedule suitable for the physical and social environment where the outcome is to be developed and implemented, informed by critical analysis of existing project management	Project schedules suitable for determining a suitable context and issue, and establishing the practice to be undertaken to develop a resulting technological outcome.	Explore the potential project schedule using: • mind mapping tools • graphic organisers • compare and contrast. Focus on answering questions such as: • Is the project schedule likely to enable a technological outcome to be developed that is fit for purpose for the physical and social environment in which it will be placed? • What constraints (political, social, moral, ethical, economic) will likely impact on the technological practice undertaken to develop a technological outcome, and the outcomes themselves? • Is the project schedule informed by critical analysis of existing project management?	
	Explore unsuccessful products and the project management practices (or lack of!!!) used to develop them	Focus on identifying the planning practice(s) that were missing What project management practices were incomplete: • Risk management • Planning tools chosen • Review points – When? How? • When could they have identified that the outcome was becoming unfit for purpose? • What constraints were identified/ not identified? • How could constraints have been considered? www.baddesigns.com http://www.youtube.com/watch?v=3rOtS7wsZCo&feature=related	
Implement project schedule, undertaking reflection at critical review points to revise or confirm schedule to ensure the effective and efficient completion of an outcome	What is meant by efficient and effective?	Define efficient and effective. What does efficiency and effectiveness look like in technology? How does the need for these two things (efficient and effective) affect project management? Evaluate efficiency and effectiveness in a practicing technologists practice - compare and contrast the fitness for purpose of the technological outcome(s) they produced with the resources (including time, waste, use of stakeholder feedback etc) they use.	
	Efficiency Competition to model what efficiency is.	Students in groups, each group has same resources, time and instructions etc to create a one-off product. Students plan before the task what they could do to ensure efficiency (for example, use minimum resources/use mock-ups and patterns to ensure efficient use of materials). Evaluate the success of planning practice against the quality of the one-off product they create (its fitness for purpose).	
	Effective Competition	Students in groups, each group has same resources, time and instructions etc to create a one-off product. Students plan before the task what they could do to ensure effectiveness Evaluate the success of planning practice against the quality of the one-off product they create (its fitness for purpose).	
	Students aware of the integrative nature of planning for practice and project management.	Students encouraged to critically evaluate their planning practices to determine their effectiveness in informing next steps. This evaluation should focus on answering questions such as: • Is the planning and management tools supporting informed projections as to where to next? • What information is missing to allow informed projections? • Is there a better means of/tool for planning and managing that would allow a more efficient use of resources and better projections to occur?	

Manage the project to provide evidence of the coordination of goals, planning tools, resources and progress review points and justify planning decisions.	Strategies for future projection – use of creative thinking strategies.	Examples include: • 'What if…' questions • De Bono • inquiry learning strategies • organisations of think tanks • Secondary Futures resource.	
	Critically evaluate others (practicing technologist) project management practices through analysis of case studies and/or their actual practice undertaken as observed/presented.	Critically evaluate the practice of others focusing on such things as: • the management tools used • the opportunities created and/or constraints that resulted due to specific practices having been undertaken • management of resources and how/if this was undertaken in an ongoing manner through-out the technological practice which was undertaken • justifications provided for the planning and management practices adopted in terms of the physical and social environment in which the practice took place • how they ensured that their technological practice was always focused on addressing the context and issue.	

OUTCOME DEVELOPMENT AND EVALUATION

The examples of teaching strategies below are shown against specific curriculum levels. When planning a technology unit however the specific teaching strategy selected will depend on the context learning. Teachers are therefore encouraged to look across the curriculum levels to identify strategies that best match the focused teaching needs of their students and the context selected for learning.

OUTCOME DEVELOPMENT AND EVALUATION: LEVEL 1

To support students to undertake outcome development and evaluation at Level 1, teachers could:

- ensure that there is a brief with attributes against which a developed outcome can be evaluated
- establish an environment that encourages and supports student innovation when generating design ideas
- provide opportunities to develop drawing and modelling skills to communicate and explore design ideas – emphasis should be on progressing 2D and 3D drawing skills and using manipulative media such as plasticine, wire, card etc
- provide opportunities to develop skills required to produce their outcome..

Focused Learning	Teaching Strategy	Explanation	Reflection
Describe potential outcomes, through drawing, models and/or verbally	Directed conversations about possible design ideas.	Teacher provides questions for students to guide discussions when developing a potential outcome(s). For example: • What sort of materials do you think you could use to make a ……..? • How do you think you'd join the different bits of your ………… together?	
	Drawing objects to show design features.	Students draw everyday objects without worrying too much about their artistic value. Concentrate students on depicting design features – such as labeling parts and indicating materials and possibly some overall measurement of these objects. Encourage use of no erasers in the first instance – if students want to change something they have drawn then get them to use another colour.	
	Introduce the language of outcomes (mock up, model, prototype etc).	Common terminology – graphic and written description. Use strategies such as: • PSSD (Purposeful silent sustained drawing/design) and labeling. • Progressive Dictionary (as a class tool) • I Have / Who Has card game – see teachers.net/classifieds/games/topic105/11.28.06.18.01.25.html.	
Identify potential outcomes that are in keeping with the attributes and selects one to produce	Give students a brief and a selection of possible products that may or may not meet the brief.	Explore the products to determine if they meet the brief. Describe what needs to be changed to allow the product to meet the brief.	
	We (the students in this class) need something to put felts and pencils in at school. It needs to be.... (attributes relevant to students).	Discuss what would make the product suitable for holding the felts and pencils. Provide students with examples of possibly products that would resolve the need as explore if they would be suitable for putting felts and pencils into at school, such as: • an overnight bag • a plastic bag • a sunglasses case • a pencil case – metal and fabric • a drinking glass.	
	Describing existing products.	Give students a range of existing products and ask them to describe what they do (their proper function).	
Produce an outcome in keeping with identified attributes.	Record in a template the process students go through to develop their outcome.	Encourage students to describe each stage of the process and discuss whether it allowed the outcome to meet the identified attributes.	

OUTCOME DEVELOPMENT AND EVALUATION: LEVEL 2

To support students to undertake outcome development and evaluation at Level 2, teachers could:

- ensure that there is a brief with attributes against which a developed outcome can be evaluated
- establish an environment that encourages and supports student innovation when generating design ideas
- provide opportunities to develop drawing and modelling skills to communicate and explore design ideas. Emphasis should be on progressing 2D and 3D drawing skills and using manipulative media such as plasticine, wire, card etc
- provide opportunities to develop skills required to produce their outcome
- guide students to evaluate their outcome against the brief.

Indicators	Teaching Strategy	Explanation	Reflection
Describe potential outcomes, through drawing, models and/or verbally	Describe conceptual ideas graphically using 2D and 3D drawings, verbally, through modelling media,such as plasticine, clay, paper, coroflute, kitchen boxes/tubes or other modelling materials.	Provide isometric paper to assist students to draw in 3D. Encourage students to use a range of media/modes to model/describe potential outcomes.	
Evaluate potential outcomes in terms of identified attributes to select the outcome to produce	Evaluate a range of potential outcomes against a brief.	Use a template with four columns for: • a picture of the potential outcome; • labeled attributes; • labeled met/not met; • why it meets/does not meet the attributes.	
	Evaluate a range of given potential outcomes (someone else's) against given attributes to identify which ones provide the greatest opportunity to be developed into an outcome that is fit for purpose.	Use several outcomes designed for a given brief and slightly change the brief. Ask students which of the outcomes best meets the new brief and why. For example: Students make fizzy drink. At end of the lesson, discuss with them how the scones attributes may need to change if the person eating these were: diabetic; obese; their grandparents.	
		Develop a rubric to evaluate models or conceptual ideas for potential outcomes against attributes.	
	Chose a context that is well known to students and have them describe attributes of an outcome that would work within the context.	Chose a context such as: carrying school equipment to school, portable seat. Ask students to describe a potential outcome that would meet their determined attributes	
	Compare a range different outcomes to determine which best offers the potential to be fit for purpose.	Use a PMI chart to record evaluations and assist in identifying which offers the best potential to be developed into an outcome that is fit for purpose.	
Produce an outcome in keeping with the brief	Use the BP Technology Challenges to develop understandings about required attributes.	Use the BP Technology Challenges as the context for producing a quick outcome that needs to meet a desired set of attributes. Reinforce, however, to students that these are isolated activities and are not technology in its entirety, and do not necessarily following a good technological practice model. Note: this activity can also provide a link with aspects associated with technological modelling – particularly the construction skills aligned to developing physical models and mockups for testing design ideas and conceptual designs.	
Evaluate the final outcome in terms of how successfully it addresses the brief.	Dragons Den type round robin discussion. Use a class brief and ask students to talk about how their outcome meets the attributes defined in the brief.	Students present their final outcome and describe how it addresses the brief. The rest of the class (or a selected group of evaluators from the class) provide feedback as to whether they feel the presented outcome meets the attributes identified as necessary in a final outcome.	
	Evaluate a range of final outcomes (students or someone else's) against known attributes to identify those outcomes that are fit for purpose.	Use several outcomes designed for a given brief. Use a PMI chart to record evaluations and determine those that are fit for purpose.	
	Describing the attributes of a potential final outcome that addresses a known need.	Chose a context that is well known to students and have them describe attributes for an outcome that addresses a known need, such as carrying school equipment to school, a portable seat for watching sports etc.	

OUTCOME DEVELOPMENT AND EVALUATION: LEVEL 3

To support students to undertake outcome development and evaluation at Level 3, teachers could:

- ensure that there is a brief with attributes against which a developed outcome can be evaluated
- establish an environment that encourages and supports student innovation when generating design ideas
- provide opportunities to develop drawing and modelling skills to communicate and explore design ideas. Emphasis should be on progressing 2D and 3D drawing skills and using manipulative media such as plasticine, wire, card etc
- provide opportunity to develop knowledge and skills related to the performance properties of the materials/components students could use
- support students to evaluate their outcome against the brief.

Indicators	Teaching Strategy	Explanation	Reflection
Describe design ideas (either through drawing, models and/or verbally) for potential outcomes	Use the *Student Showcase* or *Case Studies* on the Techlink website to illustrate different ways in which other students have described design ideas.	Undertake a comparative analysis to identify any differences and determine the ways that effectively communicate and that are not so effective in communicating design ideas.	
	Model design ideas using sketches, mockups/ models.	Focus placed on developing student understandings and skills in using different communication techniques to describe a design idea.	
Evaluate design ideas in terms of key attributes to develop a conceptual design for the outcome	Use photographs and/or mock-ups of a range of design ideas.	Students analyse these against a set of given key attributes to determine if the design ideas have the potential to address the need/opportunity. If changes are necessary, students suggest what these might be.	
	Provide students with opportunities to sketch and mockup design ideas – evaluate these against known key attributes to determine if the ideas have the potential to be developed into a conceptual design that addresses a brief.	Focus learning not just on developing student sketching and mockup skills and techniques, but also on enhancing the quality of the tests they carry out to determine the potential of the design idea.	
	Provide a selection of technological models/ mockups of varies design ideas for a technological outcome – have students test these against known key attributes to determine if the ideas have the potential to be developed into a conceptual design that addresses a brief.	Provide students with a variety of 2D and 3D mockups, graphical representations of design ideas with descriptions, virtual models, and descriptions only of design ideas.	
Select materials/ components, based on their performance properties, for use in the production of the outcome	Students test materials to determine their suitability for use in a specific context. Provide a picture of a technological outcome and a description of the performance and aesthetic requirements of the outcome when used in its intended environment. Give students a range of materials that could be used for a specific part(s) of the outcome and have them determine their suitability for use based on their performance and aesthetic qualities. Use the same technological outcome but change the environment in which it is now to be used (for example, now used in and around sea water) – have students determine what the performance and aesthetic qualities of the material(s) used to make up the outcome now need to be due to this change in environment. Identify what materials would meet these needs.	Provide a picture of an outcome (product) and a description of its required performance and aesthetic requirements. Give students a range of materials that could be used for a specific part(s) of the outcome and have them determine and justify their suitability for use based on the materials performance and aesthetic qualities. Use the same outcomes but change the environment in which it is now to be used (for example, now used in and around sea water) – have students determine and justify what the performance and aesthetic qualities of the material(s) required to make the outcome fit for purpose in the new environment. Identify what materials would provide these qualities.	
Produce an outcome that addresses the brief	Analyse the technological practice undertaken by others when developing an outcome to identify if the outcome effectively addresses the need or opportunity.	Use case studies or portfolios of other students work – preferably from older students. Focus student attention on how the technologist determined that their outcome addressed the brief.	
Evaluate the final outcome against the key attributes to determine how well it met the need or opportunity	Student group evaluation of existing outcome(s) against the key attributes they were developed to meet.	Provide students with a range of existing outcomes and the briefs that they were developed to address – have students evaluate them to determine if they address the intended need or opportunity.	
	Student peer evaluation of their developed outcome(s) against the key attributes they were developed to meet.	Students evaluate each other's developed outcomes against the brief that they were developed to address.	

OUTCOME DEVELOPMENT AND EVALUATION: LEVEL 4

To support students to undertake outcome development and evaluation at Level 4, teachers could:

- ensure that there is a brief with attributes against which a developed outcome can be evaluated
- establish an environment that encourages and supports student innovation when generating design ideas
- provide opportunities to develop drawing and modelling skills to communicate and explore design ideas. Emphasis should be on progressing 2D and 3D drawing skills and increasing the range and complexity of functional modelling
- provide a range of materials/components and support students to develop the necessary knowledge and skills to test and use them
- guide students to evaluate outcomes in situ against key attributes.

Indicators	Teaching Strategy	Explanation	Reflection
Describe design ideas (either through drawing, models and/ or verbally) or potential outcomes	Teach a range of techniques related to communicating design ideas i.e. drawing, context specific vocabulary and modelling skills etc Focus on techniques such as: • Rapid Viz, creating 2D/3D • Necker Cubes – for an explanation see mathworld.wolfram.com/NeckerCube.htm • the use of annotations to explain drawings • graphics techniques (Technology student website – graphics).	Techniques broken down into those used for: • design idea generation (research tools, concept screening tools, etc) • testing design ideas to determine their potential to be fit for purpose • mockup and modelling techniques www.betterbydesign.org.nz.	
Undertake functional modelling to develop design ideas into a conceptual design that addresses the key attributes	Analyse past students' best practice and or teacher resources of 'best' practice in developing design ideas into a conceptual design including: • the functional modelling undertaken to test the potential fitness for purpose of design ideas • identifying how selected materials were determined as suitable, • how materials were sourced.	Use portfolios of previous student's practice, student mentoring and/or Case Studies on the Techlink website. Provide a range of existing design ideas and developed conceptual designs for students to analyse Videos or DVDs that show modelling in practice, for example: • Better by Design • Google: product design modelling videos • Technology student website - modelling	
Test the key performance properties of materials/ components to select those appropriate for use in the production of a feasible outcome	Develop students' domain specific skills in testing materials.	Conduct a series of skill related activities that focus on enhancing student knowledge of how materials can be worked and tested to determine their performance properties and therefore their suitability for inclusion in an outcome.	
	Explore limitations of the performance properties of material/components.	Conduct controlled tests of materials/components against criteria to find their physical limits (ie point of failure/what situations they are suited for and those that they are not) Use worksheets with focused questions. View videos that demonstrate the applications of materials such as: • Megastructures website • Water cube website	
	Analyse past students practice to identify how they ensured that their outcome would meet the key attributes identified as important to address the need or opportunity.	Use portfolios of previous students practice and/or Case Studies on the Techlink website.	
Produce and trial a prototype of the outcome	Analyse past students practice in using prototypes to test, evaluate and determine an outcomes fitness for purpose.	Use portfolios of previous students practice and/or Case Studies on the Techlink website. Develop a set of questions that focus on determining a prototypes fitness for purpose in addressing the brief. Use these to determine if a prototype is fit for purpose.	
	Develop skill and knowledge in manufacturing prototypes.	Rapid prototyping - see www.youtube.com/watch?v=PDLOmoQj4H0&feature=fvst	
	Use a series of photographs that demonstrate the production stages that were undertaken that led to a prototype.	Analyse photographs to determine the techniques used to produce the prototype and the trialing processes that may have taken place to determine its fitness for purpose.	

Evaluate the fitness for purpose of the final outcome against the key attributes	Enhance student strategies for seeking and analysing stakeholder feedback.	Identify advantages and limitations of different strategies for gaining stakeholder feedback including when best to use them. Strategies could include such things as: • open-question surveys, closed-question surveys – email, phone or hard copy • face-to-face structured, semi-structured or unstructured interviews • sensory testing techniques – hedonic scale.	
	Students evaluate the classes developed outcomes against the attributes they were developed to meet.	Have students evaluate each other's outcomes to determine if they address the intended need or opportunity. Each student has three post-it notes that they can make one comment on and attach it to the students work	
	Students evaluate others developed outcome against the attributes it was developed to meet	Provide students with a range of existing outcomes and the briefs that they were developed to address.	
	Dragons Den type round robin discussion.	Use a group brief and ask students to talk about how their outcome met the attributes described in the brief.	
	Explore the advantages and limitations of different analysis/data collating tools such as: • spread sheets • graphs – pie charts, bar charts, frequency, mean.	Have students interpret data that is presented using different data collating tools Students share their interpretations to identify those tools that provide similar information and those which are different. Discuss why any such differences occurred.	

OUTCOME DEVELOPMENT AND EVALUATION: LEVEL 5

To support students to undertake outcome development and evaluation at Level 5, teachers could:

- ensure that there is a brief with clear specifications against which a developed outcome can be evaluated
- establish an environment that supports student innovation and encourages analysis of existing outcomes
- provide opportunities to develop drawing and modelling skills to communicate and explore design ideas. Emphasis should be on progressing 2D and 3D drawing skills and increasing the range and complexity of functional modelling
- provide a range of materials/components and support students to develop the necessary knowledge and skills to evaluate and use them
- guide students to evaluate outcomes in situ against brief specifications.

Indicators	Teaching Strategy	Explanation	Reflection
Generate design ideas that are informed by research and analysis of existing outcomes	Analyse past students practice used in developing design ideas including their use of functional modelling.	Use portfolios of previous students practice and/or Case Studies off the Techlink website. Focus analysis on how technological modelling was used to test the potential feasibility (fitness for purpose) of design ideas.	
	Suggest additional design features and the attributes to extend an existing outcomes	Insist that the additional design features and their attributes need to be informed by and enhance already existing attributes that the outcome possesses.	
	Enhance student's visual communication techniques.	Teach students skills and techniques in visually communicating their design ideas using such things as: • Rapid Viz techniques • Photoshop • Google sketchup • Crocodile clips • Inspiration	
Undertake functional modelling to develop design ideas into a conceptual design that addresses the specifications	Analyse past students practice used in developing technological outcomes.	Use portfolios of previous students practice and/or Case Studies off the Techlink website Focus analysis on the functional modelling that took place to test the potential fitness for purpose of design ideas.	
	Develop students functional modelling techniques to: • test design ideas • communicate conceptual designs. Have them identify the advantages and limitation of each technique.	Look at models, mockups, testing and trialing techniques that allow the communication and testing of design ideas and conceptual designs • physical models – construction and testing techniques • virtual models (use of 3D modelling programmes).	
	Enhance student skills in communicating design ideas and conceptual designs.	Focus on introducing to students new skills and/or modes for communicating design ideas and conceptual designs including the use of: • CAD programs • Freehand and instrumental drawing 3D and 2D models • verbal explanations • video.	
Evaluate suitability of materials/ components, based on their performance properties, to select those appropriate for use in the production of a feasible outcome	Analyse Case Studies of others practice to identify how they have justified materials/ components as being suitable for use in their technological outcome(s).	Focus analysis on the research and testing that was undertaken to determine material/component suitability.	
	Develop an attribute profile for the materials used in an existing product that is familiar to students, such as chairs around the school.	Match material specifications to the specifications needed for the product to be fit for purpose. See: • www.designmuseum.org • www.si.edu • www.designcouncil.org.uk	
	Have a practicing technologist explain how they determine the suitability of a material(s) for a specific function within a technological outcome.	• www.powerhousemuseum.com/designersatwork	

Produce and trial a prototype of the outcome	Explore a variety of tools that can support the development and trialing of a prototype.	Explore tools such as: • 3D modelling programs – AutoDesk, ProDesktop/ ProEngineer, SketchUp • 2D, 3D – hard materials, cardboard • video – capturing trial results/outcome • Photoshop, InDesign and/or Illustrator – these programs can enable the prototype to be shown virtually in its intended social and physical environment.	
	Students analysis and compare existing products related to their concept design	• Technology student website – product comparisons	
	Analyse others practice to determine the nature of the overall practice they applied, and the technological modelling tools and techniques they used to test their prototype.	Use exemplars of previous students work and/or Case Studies off the Techlink website.	
	Supporting students with specialist knowledge and experience in constructing/manufacturing processes to realise a prototype.		
	Trialing a prototype to demonstrate its potential to address the brief.	Test the performance of the prototype in situ against the brief specifications to determine its fitness for purpose.	
Evaluate the fitness for purpose of the final outcome against the specifications.	Analyse case studies of others practice to identify the tools and strategies they used to justify their outcome(s) as fit for purpose.	Use exemplars of previous students work and/or Case Studies off the Techlink website and/or the work of a practicing technologist	
	Dragons Den presentation.	Students present their prototype and justifications as to why it is fit for purpose – others evaluate if the justifications provided are convincing or not.	
	Student present their prototypes and findings from trialing using written evaluations, powerpoint and/or a video presentation.	Presentation of prototype to an audience for evaluative feedback.	

OUTCOME DEVELOPMENT AND EVALUATION: LEVEL 6

To support students to undertake outcome development and evaluation at Level 6, teachers could:

- ensure that there is a brief with clear specifications against which a developed outcome can be evaluated
- establish an environment that supports student innovation and encourages critical analysis of existing outcomes
- support students to develop drawing and modelling skills to communicate and explore design ideas. Emphasis should be on progressing 2D and 3D drawing skills and increasing the range and complexity of functional modelling
- support students to explore a range of materials/components and to develop the necessary knowledge and skills to evaluate and use them
- support students to undertake prototyping to evaluate the outcome's fitness for purpose and identify any further development requirements
- support students to gain targeted stakeholder feedback.

Indicators	Teaching Strategy	Explanation	Reflection
Generate design ideas that are informed by research and the critical analysis of existing outcomes	Have students critically analyse a case study or an existing technological outcome from others prior practice to identify those features which completely address the specifications it was designed to perform/ meet and those that were only partly addressed.	Identify the types of knowledge and understandings required by the technologist (person who made the outcome) in order to produce their outcome(s). Have students focus on: • the materials that were used • the tests undertaken to justify the outcomes addressing of the need or opportunity • component parts included in the outcome – what part do they play in the overall function/aesthetic qualities of the outcome • the knowledge from other domains that the technologist drew on to develop their outcome? • identifying the opportunities that exist to improve the outcome.	
	Analyse existing products that have similar functional properties to those required in the outcome students are developing.	Use a PMI chart to identify those functional properties that may be useful to consider when the students develop their own outcome – identify design ideas for how these could be included into their outcome.	
	Encourage students to access stakeholder feedback and considered this when generating their design ideas.	Students need to identify their key stakeholder/s and determine the tools they will use to obtain this feedback.	
Undertake functional modelling to refine design ideas and enhance their ability to address the specifications .	Develop students functional modelling techniques to: • test design ideas • communicate conceptual designs	Look at models, mockups, testing and trialing software that enables the communication and testing of design ideas and conceptual designs such as: • ProEngineer (3D modelling software) • Blender (shareware) Explore ways/techniques to test design ideas and conceptual designs including: CAD programs; physical drawing; 3D and 2D physical models; verbal - Audacity – voice thread; video. Analyse advantages and disadvantages of each testing/ communicative technique.	
	Explore techniques for gaining wider community feedback	Explore techniques for effectively communicating design ideas to the wider community including: email; Skype; phone; fax; solid modelling. Analyse advantages and disadvantages of each communicative technique.	
Evaluate design ideas in terms of their ability to support the development of a conceptual design for a feasible outcome	Use photographs and/or mock-ups of existing design ideas.	Students analyse against a set of given specifications to determine if the design ideas have the potential to address the need/opportunity. If changes necessary suggest what these might be.	
	Provide students with opportunities to sketch and mockup design ideas – evaluate these against known key specifications to determine if the ideas have the potential to be developed into a conceptual design that addresses a brief.	Focus learning not just on developing student sketching and mockup techniques but also on enhancing the quality of the tests they carry out to determine the potential of the design idea.	
	Provide a selection of technological models/mockups of varies design ideas for an outcome – have students test these against known key specifications to determine if the ideas have the potential to be developed into a conceptual design that addresses a brief.	Provide students with a variety of 2D and 3D mockups, graphical representations of design ideas with descriptions, virtual models, and descriptions only of design ideas.	

Evaluate the conceptual design against the specifications to determine the proposed outcomes potential fitness for purpose	Students analyse a variety of tools that support functional modelling.	Explore, analyse and develop skills in using functional modelling tools such as: • 3D modelling programs – AutoDesk, ProDesktop/ ProEngineer, SketchUp • 2D, 3D – hard materials, cardboard • video – capturing in terms of virtual representation • Photoshop, InDesign and/or Illustrator – these programs can enable the prototype to be shown virtually in its intended social and physical environment.	
	Analyse others practice to determine the nature of the overall practice they applied to determine the fitness for purpose of conceptual designs and the functional modelling they used to do this.	Use exemplars of previous students work or Case Studies off the Techlink website.	
Evaluate suitability of materials/ components, based on their performance properties, to select those appropriate for use in the production of a feasible outcome	Analyse their own and others technological practice to identify how they have justified their selection of materials/components.	Have students present and justify their findings.	
	Analyse case studies of others practice to identify how they have justified material suitability for their technological outcome(s).	Use resources such as: • Nuffield books • STAR profiling • Inspiration software • SKRBL software to assist students to identify the materials/components used and explore their attributes/reasons why they may have been selected for the inclusion in the outcome.	
	Develop an attribute profile of the materials/ components used in an existing product which is familiar to students. Repeat activity with products which students are initially not familiar with.	Do exercises such as SCUMPS – size, colour, uses, materials, parts, shape. Relate these prompts to 'what if…' questions. For example: • What if you change the colour of the outcome/materials…? • What if you change the use of the outcom…?e • What if you change the materials used in the outcome…? • What if you change a part of the component…? • What if you change the shape of the outcome…?	
Produce and trial a prototype of the outcome to evaluate its fitness for purpose and identify any changes that would enhance the outcome	Explore a variety of tools and techniques that can support the production of a prototype and determine their advantages and limitations.	Prototyping tools and techniques explored could include: • CAD programs – AutoDesk, ProDesktop/ProEngineer, SketchUp • 2D, 3D – hard materials, cardboard • video – capturing in terms of virtual representation • Photoshop, InDesign and/or Illustrator – these programs can enable the prototype to be shown virtually in its intended social and physical environment.	
	Support students with specialist knowledge and experience in construction/ manufacturing processes.	Use an outside expert to demonstrate and instruct students in the use of these tools/techniques.	
	Trial a prototypes performance and evaluate its fitness for purpose.	Use either an existing prototype with a known set of specifications that it was required to meet or students own developed prototype. Focus on enhancing students trialing and evaluation techniques. Students suggest changes that would enable the outcome to be fit for purpose.	
	Analyse others practice to determine the nature of the overall practice they applied, and the trialing techniques they used to test their prototypes fitness for purpose.	Use exemplars of previous students work and/or Case Studies off the Techlink website.	
Use stakeholder feedback to support and justify key design decisions and evaluations of fitness for purpose.	Analyse case studies of others practice to identify the tools and strategies they used to seek stakeholder feedback and key design decisions and evaluations of fitness for purpose.	Peer Evaluation: presentation of findings to the class for evaluative feedback. Written personal evaluation. Video presentation.	

OUTCOME DEVELOPMENT AND EVALUATION: LEVEL 7

To support students to undertake outcome development and evaluation at Level 7, teachers could:

- ensure that there is a brief with clear specifications against which a developed outcome can be evaluated
- establish an environment that supports student innovation and encourages critical analysis of existing outcomes
- support students to critically analyse evaluative practices used within functional modelling
- support students to develop drawing and modelling skills to communicate and explore design ideas. Emphasis should be on progressing 2D and 3D drawing skills and increasing the range and complexity of functional modelling
- support students to explore a range of materials/components, and to develop the necessary knowledge and skills to evaluate and make effective use of them
- support students to undertake prototyping to gain evidence that enables clear judgments regarding the outcome's fitness for purpose and determine the need for any changes to enhance the outcome
- support students to gain targeted stakeholder feedback and understand the implications of the physical and social environment in which the outcome is to be located.

Indicators	Teaching Strategy	Explanation	Reflection
Generate design ideas that are informed by research and critical analysis of existing outcomes	Analyse a case study or outcomes from a student's prior practice and/or a practicing technologist to determine how it was justified as being fit for purpose.	Identify the knowledge and understandings that the student or technologist needed to know in order to produce the outcome(s). Questions that could be used to support this analysis may include: • What materials were used in the outcome? • How were these determined to be fit or purpose? • What prior knowledge was required to develop the outcome? • How did this inform the development of the outcome? • How did the student/technologist test their outcome to ensure its fitness for purpose? • What types of components were included in the outcome – what part do they play in ensuring the overall fitness or purpose of the outcome?	
	Analyse Frank Geary – sketch modelling (modelling before sketching).	For support material, Google: Frank Geary sketch modeling.	
Develop design ideas for outcomes that are justified as feasible with evidence gained through functional modelling	Trial ways of functional modelling to test and communicate design ideas. Identify advantages and disadvantages of each model and determine situations when each is best to use.	Explore modelling, mockups, testing, trialing software that enables functional modelling to be undertaken. Examples of such software include: • Autodesk • Blender (free software)	
	Explore strategies to gain wider community feedback.	Explore means of capturing evidence of testing and communicating design ideas using: • CAD programs • physical drawing • 3D and2D physical models and mockups • verbal - Audacity – voice thread • video Using communication tools to communicate conceptual ideas to key and wider community stakeholders such as: • email • Skype • phone • fax • solid modelling	

Critically analyse evaluative practices used when functional modelling to inform own functional modelling	Analyse case studies of others practice to identify the evaluative practices they used when functional modelling.	Determine how a technologist justified the design idea/ conceptual designs potential to be fit for purpose.	
	Critically analyse tools that support evaluative practices when functional modelling.	Examples of evaluative tools that support functional modelling include: • CAD programs – AutoDesk, ProDesktop/ProEngineer, SketchUp • 2D, 3D – hard materials, cardboard • Video – capturing in terms of virtual • Photoshop, InDesign and/or Illustrator – these programs can enable the prototype to be shown virtually in its intended social and physical environment.	
Undertake functional modelling to evaluate design ideas and develop and test a conceptual design to provide evidence of the proposed outcome's ability to be fit for purpose	Analyse others practice to determine the nature of the overall practice they applied and the functional modelling they used to test and develop their design ideas into a conceptual design.	Use exemplars of previous students work, Case Studies from the Techlink website or a visit to a practicing technologist to observe and discuss their practice when developing design ideas into a conceptual design. Focus on the functional modelling techniques that were used to test and inform the development of conceptual designs.	
	Using functional modelling to test design ideas and gain stakeholder feedback.	Use PMI charts to order and sort results from testing and stakeholder feedback. Evaluate to determine design ideas potential as a conceptual design.	
Evaluate suitability of materials/components, based on their performance properties, to select those appropriate for use in the production of a feasible outcome	Analyse case studies of others practice to identify how they determined the suitability of materials/components based on their performance properties.	Have students present and justify their findings to the class.	
	Explore material/component testing techniques to test their potential fitness for purpose for inclusion in an outcome.	Trial a range of different materials/ components and testing techniques that focus on determining performance properties. Explore how the testing techniques may need to change depending on the environment in which the material/ component is being tested and/or the performance properties being tested	
Undertake prototyping to gain specific evidence of an outcomes fitness for purpose and use this to justify any decisions to refine, modify and/or accept the outcome as final	Expose students to a range of prototyping techniques (internet, YouTube).	Students produce a prototype(s) that can be tested in situ and evaluated against the brief specifications.	
	Identify the key element/s to be tested in a prototype and how the test could be conducted.	Explore how others conduct tests to determine the fitness for purpose of their prototype(s) – analyse findings to determine tests which may be suitable to conduct for their own developed prototype.	
	Construct a prototype and test it to determine its fitness for purpose.	Use stakeholder feedback during testing as well as the results of the tests themselves to determine whether to refine, modify or accept the outcome.	
Use stakeholder feedback and an understanding of the physical and social requirements of where the outcome will be situated to support and justify key design decisions and evaluations of fitness for purpose.	Develop evaluation criteria to determine the key design decisions which need to be made and to justify an outcome as fit for purpose.	The criteria developed should allow informed experts/focus groups to judge the success or otherwise of the outcome. Students will need to access the environment/location where the outcome is to be placed in order to evaluate all the environmental factors both known and unknown (physical and social) that can impact on the outcome.	
	Develop understandings of the techniques used to gain key and wider community stakeholder feedback such as: • using random selected, representative sampling or control group testing panels • monadic testing • paired-comparison testing.	Trial different techniques with key and wider community stakeholders using an existing product and known specifications to determine when best to use these techniques and the validity and reliability of the feedback received.	

OUTCOME DEVELOPMENT AND EVALUATION: LEVEL 8

To support students to undertake outcome development and evaluation at Level 8, teachers could:

- ensure that there is a brief with clear specifications against which a developed outcome can be evaluated
- establish an environment that supports student innovation and encourages critical analysis of existing outcomes and knowledge of material innovations
- support students to critically analyse the ways in which the fitness for purpose of existing outcomes have been determined, and how appropriate development practices were established
- support students to develop drawing and modelling skills to communicate and explore design ideas. Emphasis should be on progressing 2D and 3D drawing skills and increasing the range and complexity of functional modelling
- support students to explore a range of materials/components and to develop the necessary knowledge and skills to evaluate and make effective use of them.
- support students to establish which materials/components would be optimal for use when taking into account all contextual dimensions
- support students to undertake prototyping to gain evidence that enables clear judgments regarding the outcome's fitness for purpose and determine the need for any changes to enhance the outcome

support students to gain targeted stakeholder feedback and understand the implications of the physical and social environment in which the outcome is to be located.

Indicators	Teaching Strategy	Explanation	Reflection
Generate design ideas that are informed by research and critical analysis of existing outcomes and knowledge of material innovations	Compare and contrast the knowledge used by practicing technologists - use live presentations by technologists and/or case studies /DVDs of technologists practice.	What knowledge did the technologists need to know in order to generate design ideas that offered a contribution to allowing an outcome to be fit for purpose - how did this knowledge differ between the technologists. Use a graphic organiser such as Inspiration software to compare and contrast the knowledge they used.	
	Compare and contrast the research techniques used by practicing technologists - use live presentations by technologists and/or case studies /DVDs of technologists practice.	Use a graphic organiser such as Inspiration software to compare and contrast the research techniques they used. Determine situations where one technique may be more suitable than another.	
	Determining the difference between analysis and critical analysis	Case Studies from the Techlink website /DVDs of technologists practice and/or students past technological practice to identify features of 'critical analysis' as opposed to an 'analysis'. Use a graphic organiser such as Inspiration software to compare and contrast these differences.	
Develop design ideas for feasible outcomes that are justified with evidence gained through functional modelling that serves to gather evidence from multiple stakeholders and test designs ideas from a range of perspectives	Trial ways of modelling to test and communicate feasible outcomes. Identify advantages and disadvantages of each model and determine situations when each would be best to use.	Explore modelling, mockups, testing, trialing software that enables you to model: Autodesk and Blender (free) Identify the advantages and limitations of this software. Capture evidence for testing design ideas with multiple stakeholders and communicating design ideas using: CAD programs; physical drawings; 3D and2D physical models and mockups; verbal - Audacity – voice thread; video.	
	Students explore strategies to gain key and wider community feedback	Identify advantages and disadvantages of using tool to communicate conceptual ideas to key and wider community stakeholders such as: email; Skype; phone; fax; solid modelling	
	Use of thinking tools to support justification of the potential fitness purpose of design ideas.	Explore thinking tools such as: • CAMPER (consequences, actions, minimisations...) • SWOT/SWOB analysis • Waterfall questions • 'What if…' questions	
	Developing student skills in using tools to support functional modeling.	Functional modelling tools could include: • CAD programs – AutoDesk, ProDesktop/ProEngineer, SketchUp, Vectorworks • 2D, 3D – hard materials, cardboard • video – capturing in terms of virtual • Photoshop, InDesign and/or Illustrator – these programs can enable the prototype to be shown virtually in its intended social and physical environment..	

Undertake evaluation of design ideas informed by critical analysis of evaluative practices to support the development of a conceptual design for an outcome that optimises resources and takes into account maintenance and disposal implications	Break down complex ideas into smaller, more understandable parts.	An example could be Inspiration, see: • www.inspiration.com/Inspiration • www.ted.com/talks/pattie_maes_demos_the_sixth_sense.html	
	Analyse the relationship between the materials and their use within a technological outcome.	Topic = material (for example, theuse of silver within an item of jewellery) and topics for discussion are A= physical properties of material B= environmental consideration for its inclusion in the outcome (both during development of the outcome and in use within its intended environment C= fitness for purpose of material within overall outcome. Ask students to discuss the material in relation to topics ABC (Note: more topics can be added to increase the complexity of this activity) Use techniques such as CAMPER (consequence,....) and SCAMPER (substitute, consequences, actions, minify/modify/magnify, put into another use, eliminate, reverse) to focus on enhancing students ability to critically analyse.	
Undertake functional modelling of the conceptual design to provide evidence that the proposed outcome has the potential to be fit for purpose	Analyse others practice to determine the nature of the overall practice they applied and the functional modelling they used to test their developing outcome.	Use exemplars of previous students work, Case Studies from the Techlink website or a visit to a practicing technologist for students to observe and discuss their practice. Focus analysis on functional modelling techniques that were used to test and inform the development of the outcome(s) and ensure its overall fitness for purpose.	
Evaluate suitability of materials/components, based on their performance properties, to select those appropriate for use in the production of a feasible outcome that optimises resources and takes into account maintenance and disposal implication	Analyse case studies of others practice to identify how they have justified the suitability of materials/components they have included (and if possible excluded) for use in an outcome.		
	Students present and justify their outcomes as being fit for purpose to an expert technologist (Dragons Den format) and receive their feedback.	Focus student justifications on how they: • determined the suitability of materials/components included outcome • considered how to optimises the resources used to develop an outcome • considered the maintenance and disposal requirements of the outcome post its implementation.	
	Identifying advantages and disadvantages of materials/components testing techniques to test the fitness for purpose for inclusion in an outcome	Techniques explored could include those such as: • using randomly selected, representative sampling or control group testing panels • monadic testing • paired-comparison testing.	
Undertake prototyping to gain specific evidence of an outcomes fitness for purpose and use this to justify any decisions to refine, modify and/or accept the outcome as final	Expose students to a range of prototyping techniques (use the internet, YouTube)	Students produced prototypes need to be placed in situ and evaluated against the specifications. Suggestions for refinements/ improvements to the prototype justified against test findings.	
	Use of evaluative experts/focus group.	Use of an informed experts/focus groups to evaluate the fitness for purpose of the prototype.	
Use stakeholder feedback and an understanding of the physical and social requirements of where the outcome will be situated to support and justify an evaluation of the outcome and development practices as fit for purpose.	Develop evaluation criteria to determine the key design decisions that need to be made and justify the outcomes as fit for purpose.	The criteria developed will need to allow an informed experts/focus group to judge the success or otherwise of the outcome. Students will need to access the environment/location where the outcome is to be located in order to evaluate all of the environmental factors both known and unknown. (physical and social) that may impact on the outcome.	
	Presentation to an expert and/or stakeholder (key and wider community) forum	Demonstrate that the evaluation undertaken to determine the fitness for purpose of an outcome was robust and considered all of the functional and physical properties required in the outcome.	

CHARACTERISTICS OF TECHNOLOGY

The examples of teaching strategies listed below are shown against specific curriculum levels. Many of these strategies listed however are appropriate at multiple curriculum levels. When selecting a strategy to address a specific learning need(s) of students, teachers are encouraged to look across the curriculum levels to identify the strategy(ies) that best matches the focused learning needs of their students and the context they have selected for learning in technology. For example where the focus for next student learning is on getting them to 'justify' rather than just 'explain' their decisions then the teaching strategy adopted will need to allow a focus on improving student abilities to 'justify'.

CHARACTERISTICS OF TECHNOLOGY: LEVEL 1

To support students to develop understanding of characteristics of technology at Level 1, teachers could:

- provide opportunities for students to discuss what is meant by the made, natural, and social world and guide them to identify technological outcomes as making up a significant part of the made world
- provide students with examples of technologists and guide them to identify the sort of things they do as part of their technological practice. Technological practice involves the defining practices underpinning the development of a brief, the organising practices underpinning planning, and the production and evaluation practices involved in the development of an outcome that is fit for purpose as defined by the brief
- guide students to identify that the aim of technology is to design and make outcomes for an identified purpose.

Indicators	Teaching Strategy	Explanation
Identify that technology helps to create the made world	Using pictures of products or actual objects have a teacher led discussion about what they do, and how technological practice helps create the made world.	Answer questions such as: • What is the purpose of the product/object? • How has technological practice helped create the made world as we know it?
	Walking activity.	Go for a walk and identify those objects that are a result of technology and those that are not – identify characteristics that make objects a technology.
	Analysing student familiar products.	Students bring in toys from home and discuss things such as: • Why was this toy made? • What did the technologist do to make the toy?
Identify that technology involves people designing and making technological outcomes for an identified purpose	Using student-familiar products (or pictures of products) have a discussion with students to find out what they know about the technical practice that may have been undertaken by a technologist to make a product. Note: Also encourage discussion around the intention and purposeful of this activity.	Use products known to students, such as toys students play with – discuss: • What the technologist needed to do and know to make them • What age range of children/adults play with the products • What the purpose of the product is - what it does
	Provide students with a food product (such as a pizza) and a range of ingredients and ask them to choose which ones they think would have been used to make the pizza.	Challenge students to explain those they think were used by asking: 'Why?'.
	Use a range of images / outcomes of both familiar and unfamiliar items.	On a graphic organizer, have students record who the intended user might be, and the reason they needed the outcome.
Identify that technological practice involves knowing what you are making and why, planning what to do and what resources are needed, and making and evaluating an outcome.	Visit to a practicing technologist to see the work they are involved in doing.	Discuss things such as: • What it is a technologists does • How they know people will want the outcomes they produce • How they know what materials/resources they will need to make their outcomes.
Identify that technological practice involves knowing what you are making and why, planning what to do and what resources are needed, and making and evaluating an outcome.	Visit to a practicing technologist to see the work they are involved in doing.	Discuss things such as: • what it is a technologists does • how they know people will want the outcomes they produce • how they know what materials/resources they will need to make their outcomes.

< back to Contents page

CHARACTERISTICS OF TECHNOLOGY: LEVEL 2

To support students to develop understanding of characteristics of technology at Level 2, teachers could:

- provide opportunities for students to discuss the made, natural, and social world and guide them to explore how technology relates to each of these
- provide students with examples of different technologist's practice and guide them to identify any social and/or environmental issues that might have influenced their practice and the nature of the outcomes they produce. For example; social attitudes to the environment has resulted in some technologists choosing to only use renewable materials, cold and windy environmental considerations requiring clothing outcomes that have insulating and close-fitting attributes
- provide students with examples of technological outcomes and guide them to explore how these have changed over time and identify any changes that have resulted in terms of people's capability to do things. Examples should allow students to recognize that increasing capability to do things may result in both positive and negative impacts on the person, society and/or the environment
- provide students with the opportunity to explore a range of technologies and guide them to identify examples of positive and negative impacts on people, society and/or the environment.

Indicators	Teaching Strategy	Explanation
Describe the relationship between technology and the made, natural and social world	Discuss differences between products, naturally occurring objects and social systems (such as the school timetable)	Have students categorise objects (products, natural objects, and social systems). Discuss relationships and what defines them as belonging to these categories.
Identify social and/or environmental issues that may have influenced particular technological practices and/or the attributes of outcomes produced	Identify what influenced the attributes of familiar products.	Use familiar products (such as convenience food, breakfast food, school bag, sports boots), and: • identify their attributes • identify why these attributes are important to the function of the product • ask why these attributes are important.
	Compare "old" and "new" versions of technological outcomes (products), such as domestic phone versus cell phone, games (board games versus electronic).	Using pictures of old telephones (timeline of photos) discuss with students how people have expanded their lives through communication. Ask students: • What do you use phones for today? • Who uses them? • What were the older phones able to do? • What limits the ability of older phones to be useful today?
	Explore examples of technological developments in history and discuss how they have changed how people do things.	Technology student website - technological developments in history.
	Using a Venn diagram, compare old and new technological outcomes, such as a fax machine and texting.	Ask questions such as: • What kind of technological outcomes are referred to as 'old' and 'new'? • What functions do they perform that are the same/different? • What technologies do they posses that are the same/different?
Describe how particular technological outcomes have changed over time and identify if this resulted in changing how people do things	Compare "old" and "new" versions of technologies (products), such as operator required phone versus push button phone, games (board games versus electronic), coal range versus electric oven, convention oven versus microwave oven.	Using pictures of technologies (timeline of photos) discuss with students how people advances in these technologies have resulted in changes in how people do things. Ask students: • What do people do differently today as a result of the advancements in …. (cooking appliances, telecommunications/phones etc)? • What were the older technologies able to do? • What do the new technologies now enable that is different?
Describe examples to illustrate when technology has had a positive impact on society and/or the environment	De Bono's Thinking Hats = Yellow hat	Choose a technological outcome (such as car, TV, soft drink...) and discuss: • how the technological outcome has helped people • how the technological outcome has impacted on the environment.
	PMI (Plus, Minus, Interesting)	Chose technological developments that are both obviously positively or negatively impact on society (or ones that can be both). A plastic drink bottle, for example, is positive on people health but negative for the environment.
Describe examples to illustrate when technology has had a negative impact on society and/or the environment.	De Bono's Thinking Hats = Black hat	As above, but discuss how the technological developments have harmed people and the environment.

CHARACTERISTICS OF TECHNOLOGY: LEVEL 3

To support students to develop understanding of characteristics of technology at Level 3, teachers could:

- provide students with examples of different technologist's practice and guide them to identify how social and environmental issues could have influenced their decision making about; what should be made and why, how planning should be done and what resources should be used, how materials could be manipulated and tested, how outcomes should be evaluated, and manufacturing considerations
- provide students with the opportunity to explore a range of technologies and guide them to determine why they have changed over time. Reasons for changes include such things as changing needs, fashions, attitudes, ethical and environmental stances etc., or the development of new materials, skills and knowledge
- guide students to determine the impacts different technologies have had on society and/or the environment over time
- provide students with opportunities to discuss technological knowledge as knowledge that technologists agree is important for the development of a successful outcome and that if this knowledge is useful for a number of situations it can be codified for quick reference. For example; material tolerances, ratios, dosage.

Indicators	Teaching Strategy	Explanation	Reflection
Describe how societal and/or environmental issues can influence what people decided to make, how they would undertake planning, the selection of resources, and how they would make and test an outcome	Use discussion starter cards to engage students in debate	Cards contain written descriptions and/or pictures of a social and/or environmental issue (such as recycling, obesity, security, reducing consumption) and descriptions and/or pictures of real technological practice. Use these cards as starters to discuss how has XXX issue affected ZZZ?	
	Analyse contemporary and historical contexts where environmental and/or social issues have influenced the development of a technological outcome. For example: open-cast mining; power generation – turbines in the Kaipara harbor, wind farms, coal/gas generation, hydro generation; car airbags.	Develop a set of questions specific to the context being studied. Identify the agencies (Department of Conservation, local iwi, etc) that would have an impact on decisions in how the technological outcome was developed.	
	Train PowerPoint that explains what determined the gauge of train tracks.	Use to PowerPoint as a means for students to identify consequences of cause and effect	
Explain why particular technological outcomes have changed over time	Set objects, pictures and/or words that describe how a technological outcome has evolved over time, such as can openers, baby buggies, egg beaters.	Answer questions such as: • Why have they changed? • What caused this change: ergonomics?; planned obsolescence?; evolution of materials (plastics, synthetics, electronic components, etc)?	
	Create a timeline of a range of dissimilar technological outcomes.	Technology student website – timelines activity.	
	Students choose a technological outcome and investigate its development over history.	Technology student website - bicycles example. Technology student website - clocks example.	
Describe examples of how technology has impacted on the social world over time	Using an existing technology talk about how it impacted on a particular group.	Discuss: • What has happened to people as a result of the implementation of the technology? • How has the technology evolved over time due to its impact on the group? Produce a timeline with photographs of the product as it has evolved over time and a description of what has changed.	
	Topical images of technologies (such as milk powder, windmills, light bulbs etc).	What impacts have these technologies had on peoples lives? Use De Bono's Thinking Hats to get different perspectives.	
	Interview an older person about the technologies they have interacted with.	Interview an older person about life in earlier times. Have students listen and then identify the technological outcomes/products that are not present today.	

Describe examples of how technology has impacted on the natural world over time	Discuss changes to the physical environment due to the introduction of a technological outcome. Compare photographs from current and historic periods.	Use a set of historic and contemporary photographs of similar technologies (such as a bicycle). Ask students to identify the key changes in the technologies over time and ask what may have caused these. Use Te Ara or Digistore to source images, audio and other information.	.
Identify that technological knowledge is knowledge that technologists agree is useful in ensuring a successful outcome	Bubble-chart of possible knowledge required by students to develop a technological outcome that addresses an issue.	Students to: • pick knowledge that they consider will be relevant to addressing the issue • identify knowledge that is missing in the bubble-chart.	
	Need-to-know chart.	Students answer the following • What do we know? • What do we need to know? • How do we find out?	
	Use *Bro Town* and/or *The Simpsons* video clips to identify current issues.	What do I need to know to make 'this' work?	
	Provide students with an issue or need and ask them: What do I need to know to: • develop an outcome that addresses the issue/need? • evaluate the outcome as fit for purpose?	Focus students initially on identifying the generic knowledge that is required to undertake technological practice rather than specific context knowledge required to develop the outcome.	
	Identify the specific knowledge (context knowledge) needed to ensure a basic technological outcome functions (such as a suitable food product as an afterschool snack)	For example, the specific knowledge required to develop a suitable food product as an afterschool snack includes: ingredients, health and safety, safe oven use, temperature, utensils, cost, mixing, measurements, nutrition, storage, an understanding of consumer preferences, knowledge of evaluation including sensory evaluation, shelf-life, cost, nutritional benefits etc.	

CHARACTERISTICS OF TECHNOLOGY: LEVEL 4

To support students to develop understanding of characteristics of technology at Level 4, teachers could:

- provide students with opportunities to examine a range of technologies that have and/or could expand human possibilities by changing people's sensory perception and/or physical abilities. Examination of technologies should allow students to gain insight into how decisions are based on both what could and what should happen
- guide students to understand that 'expanding human possibilities' can result in positive and negative impacts on societies and natural environments and may be experienced differently by particular groups of people
- provide students with opportunities to examine and debate examples of innovative technologies that resulted in new possibilities. Examples should draw from the past and present and allow students to identify the creative and critical thinking that underpinned the developments.
- provide students opportunity to explore the wide range of knowledge and skills from diverse disciplines that support technology
- provide students opportunity to explore differences between technological knowledge and knowledge from other disciplines
- guide students to analyse a range of examples of technological practices and to identify the knowledge and skills that informed initial design decisions and ongoing manufacturing decisions. Examples should be drawn from within their own and others' technological practice and allow students to gain insight into how technological knowledge and skills, and knowledge and skills from other disciplines, can support technology practice and allow students to gain insight into the range of disciplines that can support technological developments.

Indicators	Teaching Strategy	Explanation	Reflection
Identify examples where technology has changed people's sensory perception and/or physical abilities and discuss the potential short and long term impacts of these	Have students pick a decade of New Zealand's history and find a significant technological development that occurred during this time. Identify how this technological development has expanded human possibilities	Examples of technological developments include: the Hamilton jet boat; the Buzzy bee; pavlova; the electric fence; baby formula; bungy jump.	
	Review Visa evolution ad and identify how technological developments have expanded human possibilities	Watch the Visa evolution ad (1:03) - identify the opportunities that are provided through the use of the current versions of the technologies mentioned in the clip: • cellphone • video • i-phones • computers (word processing) • EFTPOS credit and debit cards) Discuss current and potential future impacts.	
Identify examples of creative and critical thinking in technological practice	Have students Google: 'tomorrows technology' and find a New Zealand technological outcome which they can research and discuss.	Discuss a specific technology and the innovations that have allowed/need to occur to enable these technologies to be realised (developed through to implemented products). Discuss questions such as: • What is 'creative' about the technology (such as design features – functions and/or its appearance) and/or its development (such as the reason why it was developed, how it was developed)? • What 'critical thinking' may have been needed to enable the technology to developed through to implemented products?	
Identify and categorise knowledge and skills from technology and other disciplines that have informed decisions in technological development and manufacture	Analyse the technological development used to develop a technological outcome. For ideas on New Zealand developed technological outcomes google: NZ Inventions	• Contexts that could be explored include: • Top 10 New Zealand Inventions • Maungatautari Reserve Vermin-proof fence • Mountain Buggy Have students discuss questions such as: • What was the main issue(s)/problem(s) that needed resolution? • What knowledge (specific and generic) did the technologists need to resolve the issue/problem(s)? • What skills did the technologist need to resolve the issue/problem?	
Identify the knowledge and skills that have informed design decisions in particular technological developments.	Analyse the technological development used to develop a technological outcome. For ideas on New Zealand-developed technological outcomes, Google: NZ Inventions.	Contexts that could be explored include: • Top 10 New Zealand Inventions • Maungatautari Reserve Vermin-proof fence • Mountain Buggy Have students discuss questions such as: • What was the main issue(s)/problem(s) that needed resolution? • What knowledge (specific and generic) did the technologists need to resolve the issue/problem(s) • What skills did the technologist need to resolve the issue/problem?	

CHARACTERISTICS OF TECHNOLOGY: LEVEL 5

To support students to develop understanding of characteristics of technology at Level 5, teachers could:

- provide students with opportunities to examine and debate examples of innovative technological developments. Examples should draw from the past and present and allow students to explore how creative and critical thinking impacts on developments and how what could happen and what should happen were considered
- guide students to analyse a range of examples of technologies to examine how people's perceptions and/or level of acceptance has influenced the practices and decisions underpinning their development and implementation. Examples should be drawn from the past and present to allow students to gain insight into the influence past experiences have on the perception and acceptance of existing and future technological practice and outcomes
- guide students to analyse a range of examples of technological practices to identify codified technological knowledge that was used to inform design and manufacturing decisions. Technological knowledge becomes codified when technological experts consider it is useful for a number of situations. Codified technological knowledge refers to such things as codes of standards, material tolerances, and codes of practice including codes of ethics, intellectual property codes, etc. Examples should be drawn from within their own and others' technological practice
- provide students with opportunities to discuss the role of codified knowledge in technology and understand why and how particular knowledge becomes codified. Codified knowledge provides others with access to established knowledge and procedures that have been shown to support successful technological developments in the past and can serve to remind technologists of their responsibilities. In this way codified knowledge can be used to provide constructional, ethical and/or legal compliance constraints on contemporary technological practice
- provide students with opportunities to discuss how established codified knowledge can be challenged and that ongoing revision is important due to the changing made, social and natural world. For example, the development of new materials, tools, and/or techniques, shifting social, political and environmental needs and understandings, and technological outcome malfunction, can all serve to challenge existing codified knowledge.

Indicators	Teaching Strategy	Explanation	Reflection
Discuss examples of creative and critical thinking that have supported technological innovation	Students brainstorm and record all of the technological products they own or use daily.	The intention is to get students to realise they readily accept new technology because of their past experience with technology.	
	Students investigate their parent's/ grandparent's acceptance of new technology. (such as video conferencing, Thunderbirds/Star Trek, Skype, microwave).	The intention is that students will realise that other generations have had different experiences with technology than they have, and that this influences their acceptance of new technology.	
	Watch an advertisment of a new technology (such as 3D home televisions) and discuss if we should adopt this new technology.		
	Review future technologies and have students: • debate if people will accept these technology(s) should they be developed and implemented • discuss what would need to change for the technology(s) to be accepted.	Use science fiction movie extracts or trailers from a science fiction movie or trailer – see www.fancast.com/trailers or www.apple.com/trailers/genres/science_fiction Explore websites such as www.futuretechnologies.com to find an idea for a technology that is yet to be realised.	
Explain how people's past experiences of technology (both in terms of the nature of practices undertaken and the initial development and ongoing manufacturing of outcomes) influences their perception of technology	Forecasting future developments for everyday (familiar) products.	In groups, students choose an everyday technological product (such as phone, schoolbag…) and brainstorm what further development could be done to this product. Inform these ideas based on your own experiences and predictions about future needs/ technological developments. The aim is for students to understand how they can influence future development based on experience.	
	Provide students with a brief to further develop an everyday technological product.	Have students explore design ideas to enhance the functionality/appearance of technological product. Class to provide initial stakeholder feedback on student design ideas. Students then present design ideas to wider stakeholders (parents, grandparents) and compare their feedback to that obtained from the class. Use a Venn diagram to illustrate found differences between the feedback – students discuss these differences to determine possible reasons for them.	
Explain how people's perception of technology influences their acceptance of technology	Students research different people's perception of a technology and determine how this influences their acceptance of it.	Use a Venn diagram to illustrate found differences between people's perceptions – students discuss these differences to determine possible reasons for them.	

Explain how people's perception of technology impacts on future technological development	Review a Youtube video of product failure or technological disasters – for example: Iran Air or Technological disasters. Students discuss lessons learnt from such disasters and how this informed the development of codified knowledge (such as changes in building codes).	Students realise that lessons can be learnt from failure that can lead to guidelines and codes to prevent failure in the future.	
Explain how and why technological knowledge becomes codified	Students do simple task, such as package an egg, or drop an egg from a height. Successful students pass on knowledge of how it worked to others via text.	Students realise that codified knowledge is not only developed from failures, for example, knitting patterns, recipes, sewing pattern, skateboard, music genres.	
Explain the role codified knowledge plays in technological practice.	Indentify examples of where and when codified knowledge is used.	Brainstorm different occupations and subcultures (such as surfers, computer geeks, electrician, gamers, etc.). Discuss the codified knowledge that each of these groups uses	
	Activity: understanding the purpose for codified knowledge (including graphic codes).	Students brainstorm questions about the value of codified knowledge and then discuss potential answer to them. For example: • What is the purpose of the codified knowledge? • Where it is this codified knowledge used? • Who could you expect to understand this codified knowledge?	
	Codified knowledge in action.	Put an unfamiliar 'code' in front of students to see if they can read it/determine what it means. Discuss the importance of /reason for having standardised codified knowledge.	
	Have a technologist visit and talk about their responsibilities, and the Codes of Practice and Codes of Ethics they work within.	Set up a scenario where you are going to be developing a technological outcome for a local daycare centre (such as making a movie, toys or furniture). Brainstorm some of the factors you would have to consider in this situation. Using understandings gained from the visiting technologist, discuss the technologists responsibilities: • to the community (daycare centre) • to their professional organisation/peers.	
	Provide students with a practical example of how a technologist works with codified knowledge when developing a technological outcome.	Students discuss where codified knowledge was used in the development of the outcomes and how this enhanced/hindered the technologists practice in terms of their ability to: • communicate with their peers • record ideas.	

CHARACTERISTICS OF TECHNOLOGY: LEVEL 6

To support students to develop understanding of characteristics of technology at Level 6, teachers could:

- support students to analyse a range of examples of technological development and explain how different disciplines have impacted on the nature of the technological practice undertaken and how this in turn has influenced understandings of the contributing disciplines. Examples should include those from the students own work and others' technological practice and allow students to gain insight into the interdisciplinary nature of technological practice
- support students to explore examples of where collaborative work between technologists and/or other people has led to new possibilities for technological practice and/or outcome design. Examples should include those from the students own work and others' technological practice and allow students to gain insight into the way idea generation and exploration can be enhanced through collaboration
- support students to understand that interdisciplinary collaboration provides exciting opportunities to 'work at the boundaries' of established fields and appreciate that this may lead to situations where no codified technological knowledge exists to guide practice, tensions between people may arise, and a greater number of unknown consequences may result
- provide students with opportunities to discuss how the interdisciplinary nature of technology and the need for collaboration can influence how technology is understood and accepted by different groups in both positive and negative ways.

Indicators	Teaching Strategy	Explanation	Reflection
Explain how different disciplines have impacted on technological practice	Spend 15 minutes playing computer game. Brainstorm/discuss in pairs the different knowledge bases that were required to develop the game.	Students identify different knowledge bases required to develop the game such as mathematics, physics, graphics, etc. Discuss what each discipline has contributed to the overall outcome.	
	Present different examples of technological outcomes that are obvious results of collaborations For example: • a tent – textile shell and resistant structure • an electronic product – package design and electronic circuit design.	Students discuss the links between material areas, common and specific knowledge and the likely attributes that involved successful collaboration	
Explain why collaboration is important in technological developments that involve interdisciplinary work	Find an industry example or a case study that shows good collaborative practice between technologists, for example: • The Pixar story • www.melissaplasticdreams.com – Melissa shoe company collaborates with well known fashion/product designers and architects to develop new shoe products)	Students undertake independent inquiry to identify the different disciplines involved and the collaborative practices adopted by technologists and present findings to class.	
	Students explore examples of where unsuccessful collaborative practices have led to product failure, for example: • YouTube – Toy dog lips • YouTube – Exploding Ford • YouTube - Defibrillator	Students use understandings from research about attributes that contribute to successful collaboration, to determine attributes that contribute to unsuccessful collaboration.	
Explain how interdisciplinary collaboration in technology can enhance and/or inhibit technological development and implementation	Research examples where interdisciplinary collaboration in technology has enhanced and/or inhibited a technological development and its implementation.	Students present research findings in a seminar presentation to the class.	
Describe examples of interdisciplinary collaboration in technology that has influenced, or could influence on public understanding and acceptance of technology.	Research examples where interdisciplinary collaboration in technology has influenced, or could influence public understandings and acceptance of technology.	Students present research findings in a seminar presentation to the class.	

CHARACTERISTICS OF TECHNOLOGY: LEVEL 7

To support students to develop understanding of characteristics of technology at Level 7, teachers could:

- provide students with opportunities to discuss the inseparable nature of technology and society and guide them to explore examples to analyse instances of the complex intertwining of society and technology. Contexts for exploration could be selected from areas such as; communication practices and communication technologies, life experiences and medical technologies, sporting endeavours and equipment/enhancement technologies
- provide students with opportunities to discuss technology as a discipline of on-going contestation and competing priorities that require resolution through complex decision making and guide students to recognise the role of functional and practical reasoning in such decision making
- guide students to critically analyse examples of technological practice to gain insight into how technologists take competing priorities into account during decision making. Competing priorities include such things as: innovation versus acceptance/continuation; time versus quality; majority acceptance versus acceptable to all; social versus environmental benefit; ethical versus legal compliance etc. Competing priorities arise in and are dealt with differently across different aspects of technological practice. Aspects of technological practice include such things as: problem identification and refinement to establish needs and opportunities; the development of designs and technological outcomes; resource selection and justification; post development manufacturing; implementation and ongoing in situ evaluation; maintenance and disposal; and ethical, social and moral responsibilities
- guide students to critically analyse examples of innovative technological developments. Examples should draw from the past and present and allow students to gain insight into how informed creativity, critical evaluation and the pushing of boundaries can support innovative decision making and outcomes. Opportunity should also be provided to critique innovative developments in terms their impact on how technology is understood and accepted by different groups in both positive and negative ways

Indicators	Teaching Strategy	Explanation	Reflection
Discuss examples to illustrate how socio-cultural factors influences technology and in turn technology influences socio-cultural factors in complex and ongoing ways	Establish factors that technologists may face and their potential priorities when developing a technological outcome.	Brainstorm factors and priorities. Link these to other existing products that exemplify where these factors have been prioritised.	
	Review designers/technologists such as: • Victor Papanek – ethical and sustainable design • Chris Bangle – car design • Peter Jensen – fashion design.	Identify the socio-cultural factors that impacted on these technologists technological practice.	
	View Techlink Technologists' Practice case studies –www.techlink.org.nz/Case-studies/Technological-practice	Find a suitable case study that highlights the socio-cultural factors that a technologist had to deal with.	
	Visiting technologist talks to students.	Technologist talks to students about their own decision making process to make complex decisions. Answer student's pre-prepared questions that focus on identifying the socio-cultural factors they had to address when developing their product(s).	
	Choose a technological product and investigate.	Discuss what socio-cultural factors might have influenced the development of the technology.	

Explain technology as a discipline of on-going contestation and discuss why competing priorities arise	Establish all factors that technologists may face and their potential priorities.	Brainstorm all factors and priorities. Link to existing products that exemplify these priorities and may cause contestation.	
	Review designers/technologists such as: • Victor Papanek – ethical and sustainable design • Chris Bangle – car design • Peter Jensen – fashion design.	Identify the conflicts and competing priorities that impacted on these technologists technological practice.	
	View Techlink Technologists' Practice case studies –www.techlink.org.nz/Case-studies/Technological-practice	Find a suitable case study that highlights the competing priorities that the technologist had to deal with. Class discusses the role of practical and functional reasoning in complex decision making.	
	Visiting technologist	To talk about their own decision making process to make complex decisions. Answer student's pre-prepared questions that focus on identifying the competing priorities they had to address when developing their product.	
Explain how competing priorities have been managed in technological decisions of the past	Visiting technologist	Technologist talks to students about how influences and priorities have been managed in developing their technological outcome(s). Answer student's pre-prepared questions that focus on what these influences and priorities where.	
Explain how critical evaluation, informed creativity and boundary pushing impacts on technological development and public views of technology	What are boundaries and how do you push them?	Brainstorm and discuss with class. Class debate? See www.ted.com/talks/lang/eng/tim_brown_on_creativity_and_play.html	
	Critically analyse a range of innovative technological outcomes from the past and present.	Choose a range of innovative technological outcomes. Explore www.ted.com videos of the developer talking about the development of the product, or case studies on the development process.	
	Introduce concepts/contexts that deserve critical evaluation.	Explore sites such as the following for examples of critical evaluations undertaken by technologists: • www.ted.com • www.youtube.com/watch?v=boQ5unUxjuY	

CHARACTERISTICS OF TECHNOLOGY: LEVEL 8

To support students to develop understanding of characteristics of technology at Level 8, teachers could:

- support students to critically analyse examples of technological developments and their consequences, known and unknown and intended and unintended, to gain insight into the social responsibility technologists have due to the interventionist nature of technology. Examples should allow students to gain insight into how technology has real and long term impacts for the made, natural and social world. Students should be supported to discuss the implications this has for technologists' collective responsibility
- support students to understand that technology can challenge people's views of what it is to be 'human'. Contexts for exploration could include contemporary developments in the area of communication technologies, artificial intelligence, human-robotic interfaces, second-life gaming, genetic engineering, nanotechnology etc.
- support students to explore and critique the role of technology in the creation of sustainable environments. This would include discussion of such things as the ethics of designing for limited technological outcome lifespan, designing to comply with minimal engineering ideals, utilizing and developing sustainable materials, reducing energy consumption and waste, developing and managing socio-technological environments, etc.

Indicators	Teaching Strategy	Explanation	Reflection
Discuss technology as intervention by design and explain the impacts and implications of this	Critically analyse case studies of technological developments, for example: • data storage • genetic modification • medicine-antibiotics • aviation • smart materials.	Teacher supports students to explore the technological developments and their impacts (known and unknown, intended and unintended, long term and short term). Students present and discuss findings to class.	
	Class debate the role and responsibility of a technologist.	Pose the following Victor Papanek topic as the subject of debate: 'Whether designers, architects, and engineers can be held personally responsible and legally liable for creating tools, objects, appliances, and buildings that bring about environmental deterioration.' Assign students as pro or anti this view and have a formal class debate.	
Discuss why technology can challenge people's views of what it is to be 'human'	Watch movies and/or You Tube clips that challenge ideas of what it is to be human.	To introduce the concept of 'challenging what it is to be human' by watching clips such as: • www.quazen.com/Arts/Architecture/10-Mistakes-in-Modern-Table-Design.202419 • Honda Robot: • www.youtube.com/watch?v=cfaAiujrX_Y • www.youtube.com/watch?v=VTIV0Y5yAww • Swimsuit design: • blog.djsports.com/2009/08/01/swimsuit-ban-will-be-enforced-on-janurary-1-2010/ • www.jsme.or.jp/English/news08(535KB).pdf	
	Have students work in groups and produce a short skit/movie clip that challenges people's view of what it is to be human.	Students present their short skit/movie clip to the rest of the class.	
Critique the role of technology in the development of sustainable environments	Analyse technological outcomes developed to ensure sustainable environment.	Students determine attributes about these technologies that allows them to be considered as maintaining/ensuring a sustainable environment. Students use a Venn diagram to illustrate common and different attributes.	
Discuss future scenarios where technology plays out different roles and justify projected impacts.	Have students work in pairs/groups – choose a context (such as artificial intelligence, second-life gaming, genetic engineering) and research how a technology has played out different roles for different people and justify their projected impacts.	Students use research findings make a presentation to explain to the class how a technology has played out different roles for different people and justify their projected impacts.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES

The examples of teaching strategies listed below are shown against specific curriculum levels. . Many of these strategies listed however are appropriate at multiple curriculum levels. When selecting a strategy to address a specific learning need(s) of students, teachers are encouraged to look across the curriculum levels to identify the strategy(ies) that best matches the focused learning needs of their students and the context they have selected for learning in technology. For example where the focus for next student learning is on getting them to 'justify' rather than just 'explain' their decisions then the teaching strategy adopted will need to allow a focus on improving student abilities to 'justify'.

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: LEVEL 1

To support students to develop understanding of characteristics of technological outcomes at Level 1, teachers could:

- provide students with a range of contemporary and historical technological products and systems and encourage them to explore these through such things as: using, 'playing', dismantling and rebuilding as appropriate;
- guide students to recognise the products and systems explored as technological outcomes developed by people to be suitable for particular users;
- guide students to identify technological outcomes when presented with a collection of technological and non-technological objects and systems;
- guide students to identify the physical nature of technological outcomes – the physical nature of technological outcomes refers to its physical attributes, such as size, shape, colour, smell, texture, components;
- guide students to identify the functional nature of technological outcomes – the functional nature of technological outcomes refers to its functional attributes, that is, what the outcome or part of the outcome does – for example; provides grip, transports mass, stores, joins surfaces.

Focused Learning	Teaching Strategy	Explanation	Reflection
Identify technological outcomes in a group of technological and non-technological objects and systems	Discuss examples of technological outcomes.	Teacher provides examples of technological outcomes (and calls them tech outcomes) to encourage students to make a connection to people made outcomes. Whole class, or group discussion, possibly teacher record on flip chart / whiteboard. How are/were people involved in this technological outcomes development?	
	A collection of both objects and images of technological and non-technological outcomes.	Students sort objects and images into categories. Teacher-led discussion on why each outcome is placed in particular category. Whole class, or group discussion – teacher could record this on a flip chart / whiteboard.	
Identify who might use particular technological outcomes	Descriptive wall chart / poster / literacy strategy.	Using common objects, regularly practice descriptive engagement. "I've got a …….. can you guess what it is and who uses it? Brainstorm strategy/ recording sheets.	
	Discuss the different people who use and possibly make a technological outcomes, for example: baker – bread	Record discussion on flip chart	
	Match pictures of technological outcomes with potential end-users.	Match pictures and paste onto flip chart.	
Identify the physical attributes of technological outcomes	Descriptive wall chart / poster / literacy strategy.	"I've got a …….. can you guess what it does?" or "Have a look at this, what do you think it will do? Brainstorm strategy/ recording sheets. Teacher to make sure language such as size, shape, colour, small, texture, components etc. are included in brainstorm discussions. Teacher uses hidden object to support student understanding about physical nature of objects.	Known = students have heard about it or seen it, but not used it. Familiar = students have engaged with and experienced it.
	A version of the Headbands game: • Students in pairs, sitting so they cannot see each other. • One has a technological outcome (products/ systems) that they describe in terms of its physical nature, one clue at a time. • The other student either guesses what it is. • Student describing gets one point per clue. Note: the more clues it takes the better because that means they are being very specific.	Example: A vivid marker: Describe its **physical** nature: • "It comes in different colours." • "It has a lid." • "The lid has grooves in it." • "The outside of it is made of plastic."	
Identify the functional attributes of technological outcomes.	A version of the Headbands game (as above), describing functional nature.	Example: A vivid marker: Describe its **functional** nature: • "It can write on lots of different surfaces." • "Its outcome is difficult to remove." • "It comes in different colours." • "It has a lid." • "It has a round/flat tip."	
	Descriptive wall chart / poster / literacy strategy.	"I've got a …….., can you guess what it does?" or "Have a look at this, what do you think it will do? Brainstorm strategy/ recording sheets Over time, using a range of known and unknown objects, encourage discussion around their function.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: LEVEL 2

To support students to develop understanding of characteristics of technological outcomes at Level 2, teachers could:

- provide students with a range of technological outcomes and non-technological objects and guide them to identify which of these could be described as technological outcomes and explain why. Technological outcomes are defined as fully realised products and systems, created by people for an identified purpose through technological practice. Once the technological outcome is placed in situ, no further design input is required for the outcome to function. Taking this definition into account, technological outcomes can be distinguished from natural objects (such as trees and rocks etc), and works of art, and other outcomes of human activity (such as language, knowledge, social structures, organisational systems etc)
- provide students with a range of contemporary and historical technological outcomes and encourage them to explore these through such things as: using, 'playing', dismantling and rebuilding as appropriate
- guide students to identify the technological outcomes explored as products and/or systems. Identifying an outcome as a product or system will influence the description of its physical nature. For example, if a technological outcome is identified as a product, the focus for describing its physical nature will be on the physical attributes afforded by the shaping, cutting, finishing etc of the materials it is made from. If a technological outcome is identified as a system, the focus for describing its physical nature will be on the physical attributes afforded by the components within it and how they are connected
- guide students to identify the relationship between physical and functional attributes in technological outcomes. For example the flat bottom of a cup (physical attribute) allows it to be stable on a flat surface (functional attribute)
- guide students to recognise that physical and functional attributes can give clues as to who might use the technological outcome for its intended purpose.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Describe what technological outcomes are and explain how they are different to natural objects and other things created by people	Touchy feely bag/photos known and unknown objects.	Categorise objects into technological and non-technological outcomes. Set up photo/image activity to do the same.	
	Photo image activity, possibly a street scene, or an older image from inside a house (lounge room).	Give students a photograph (for example: a street scene). Provide students with a graphic organiser to write two lists: technological and non-technological outcomes. Have students explain/justify their lists.	A street scene is good because it often includes people, natural items (such as grass) and things that challenge their thinking/definitions (such as fence posts, footpaths).
Identify a technological product and describe relationships between the physical and functional attributes	Teacher has objects / objects aligned to a context for students to explore, and describe the technological outcome. This strategy could also be used with images.	Set up series of objects with starter questions for students to explore. Starter questions focus on materials objects are made from and why they're important for the outcome to function. Ask students what alternative materials the object could have been made from.	
	Venn diagram chart.	Use a Venn diagram chart to allow students to make connections between what something is made of, and what it can do.	
Identify a technological system and describe relationships between the physical and functional attributes	Have a range of technological systems / products. Get students to identify those that are technological systems and the physical attributes of their components.	Teacher to lead discussion around input, output and components, and why the connections between components is important – a remote control toy, windup toy or simple mechanical toy is good for this exercise.	
Describe the physical and/ or functional attributes of a technological outcome that provide clues as to who might use it .	Physical and functional object matching game using images.	Students identify the physical and function attributes of a technological outcome from within a topic/context that they are familiar with. Repeat exercise using a technological outcome from within a topic/context that the students are unfamiliar with.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: LEVEL 3

To support students to develop understanding of characteristics of technological outcomes at Level 3, teachers could:

- provide students with a range of technological outcomes with unknown functions to explore and guide them to make informed suggestions regarding who might use them and the possible function they could perform, as based on an exploration and analysis of their physical nature
- provide students with the opportunity to explore a range of technological outcomes that are similar in their functional nature but have differences in their physical natures and vice versa
- support students to understand that the intended use and users, socio-cultural and physical locations all combine to determine how the physical and functional attributes can be best matched for optimum fitness for purpose. For example; a selection of brooms could be described as having similar functional attributes (clean an area by sweeping unwanted material to another location, able to be used while standing) but whether they are for a young child to sweep dust of the kitchen floor or for an adult to sweep water off driveways will mean quite different physical attributes will be decided upon to ensure the broom is fit for its purpose. Alternatively, a selection of brushes could be described as having similar physical natures (all have flexible bristles) but the way in which they are used will determine their functional nature as to whether they function to clean, act as a reservoir to spread a substance, or to separate something
- guide students to understand the relationship between the physical and functional nature in a technological outcome. That is, the functional nature requirements set boundaries around the suitability of proposed physical nature options (for example a chair for a child will constrain the dimensions of the chair) and the physical nature options will set boundaries around what functional nature is feasible for a technological outcome at any time (for example heavy cast iron pots will not be suitable for everyday use by the elderly)
- guide students to understand that the judgment of a technological outcome as a 'good' or 'bad' is related to the match between its physical and functional nature, its intended user/s and the context they would normally use it in.

Indicators	Teaching Strategy	Explanation	Reflection
Describe possible users and functions of a technological outcome based on clues provided by its physical attributes	If I need something to .... it will look like............. and will need to………….	Have student focus on a specific technological outcome and complete the sentence. For example: "If I made it from metal it would be strong; if I made it from aluminum it would be light."	
	Use multiple problem scenarios to challenge students to think about possibilities for a technological outcome in terms of the end user and the physical attributes needed and what it will do in each context.	For example: "I'm working as a food technologist (chef) so if I want a mouth texture that is crunchy, what does the physical nature of the ingredients of the product need to be?"	
Describe examples of technological outcomes with different physical natures that have similar functional natures	Use multiple examples of similar products that have the same functional nature, but different physical natures. Use a combination of both actual outcomes and images of outcomes. Students source own examples to demonstrate independent understanding.	For example:. • a range of raising agents to explore how different raising agents effect the physical outcome. • A range of potato peelers, different looking ones, made from range of materials, but all have same function • categories of finishes (such as oil, varnish, paint) • a range of brushes (hair, paint, washing up ….)	
Describe examples of technological outcomes with different functional natures that have similar physical natures	Use multiple examples of similar products that have the same physical nature, but with different functional natures Explore functions of, for example, bags that are there to do similar things in terms of physical nature. Use a combination of both actual outcomes and images of outcomes. Students source own examples to demonstrate independent understanding.	The cake, the muffin, the bread, all three have similar functional natures, but each has a different physical nature.	
	Different products with the same functions.	Develop a picture chart to illustrate how different products are used for similar purposes, Explain how/ why do these products can do this.	
Explain why a technological outcome could be called a 'good' or 'bad' design.	Teacher sourced examples of 'good' or 'bad' (failed) technological outcomes.	Images and text about successful and failed outcomes. Teacher led discussion about why these technological outcomes might be perceived this way. Students in groups discuss merits of 'good' or 'bad' design using guided sentence starters.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: LEVEL 4

To support students to develop understanding of characteristics of technological outcomes at Level 4, teachers could:

- provide students with the opportunity to explore examples of technological outcomes and guide them to identify their proper function. Proper function can be determined from an analysis of both the design intent that drove the outcome's development as well as how it is most commonly used
- provide students with examples of technological outcomes where the proper function of a technological outcome has changed over time because an alternative use was successful and then became socially accepted as the norm
- provide students with examples of technological outcomes that have been used unsuccessfully for other purposes and/or in different environments and support them to identify the negative impacts. Impacts may be in terms of expected action not resulting, damage to the outcome, injury to the user, the damage to the social or physical environment – or any combination of these
- provide students with a description of an identified purpose (e.g. a stated need or opportunity) and other relevant details. These details should include such things as intended users and the environment in which it is to be situated. Support students to generate potential designs for a technological outcome and describe the physical and functional attributes it would require if it could be justified as a good design leading to an outcome that was fit for purpose.

Indicators	Teaching Strategy	Explanation	Reflection
Explain the proper function of existing technological outcomes	Teacher led discussion using a range of technological outcomes.	Object description – What is its intended use (proper function)?	
	Questions starters that are used to explore a range of technological outcomes	Encourage students to use open-ended question starters, such as: • What did we intend to use this for? • How do we know it's going to function in the way we intend? • How does its function do that?	
Explain how technological outcomes have been successfully used by end-users for purposes other than what they were originally designed for	Students discuss their own and others' experiences.	Students who take things out of the father's shed and use them for things that weren't intended to do. Teachers demonstrate and discuss how a range of technological outcomes are successfully used by end-users for purposes other than what they were originally designed for, such as using a screwdriver to open a paint tin. Explore different tools people use to do things they were never intended to do – such as cracking nuts, opening a can, taking the top off a bottle.	
Explain how technological outcomes have been unsuccessfully used by end-users for purposes other than what they were originally designed and discuss the impacts of this	Students discuss their own and others' experiences.	Provide examples of where technological outcomes have been unsuccessfully used by end-users for purposes other than what they were originally designed and discuss the impacts of this.	
Explain possible physical and functional attributes for a technological outcome when provided with intended user/s, a purpose, and relevant social, cultural and environmental details to work within	Student analyse unfamiliar technological outcomes to determine their physical and functional attributes.	Justify decisions made in a class presentation.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: LEVEL 5

To support students to develop understanding of characteristics of technological outcomes at Level 5, teachers could:

- guide students to analyse a range of examples of how technological outcomes have been evaluated as fit for purpose according to its appropriateness to the time and context of its development. Examples should be drawn from within students own and others' technological practice and allow students to examine the criteria used to make the judgment
- guide students to explore a range of examples of technological outcome failure and support them identify those that are examples of malfunction. Malfunction refers to a single event failure of a technological outcome as opposed to failure due to 'wear' or reaching the end of the outcome's designed lifespan
- guide students to analyse examples of technological outcome malfunction to gain insight into how such events can inform decisions about the future of the outcome. Decisions may be made to withdraw or modify the technological outcome or retain the outcome with modified operational parameters (operational parameters refer to the boundaries and/or conditions within which the outcome has been designed to function).

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain why time and context are important criteria for judging the fitness for purpose of technological outcomes	Identify issues/values/events for a specific time period.	Brainstorm events/issues/values for a specific time-period/decade and discuss how they influenced the products developed during that time	
	Provide a range of examples (both actual and images) of a technological outcome as it has evolved over time, such as the telephone, or music players.	Have students sort the examples into the order they perceive they evolved (timeline), suggesting actual years/decades. Research to confirm order and identify likely driving need/societal demands that influenced the functional properties of the technology. Compare two of the examples to identify their functional differences and provide an explanation of these.	
Evaluate past technological outcomes in the light of experiences subsequent to their development and/or contemporary understandings	Students to investigate an historical technology, such as turntables, steam cars.	Students identify the original proper function of the technology and predict what needs to be modified for the technology to be considered fit for purpose today. Predict modifications necessary for the technology to be fit for purpose in 10-20 years.	
Explain what is meant by the malfunction of technological outcomes .	Brainstorm, and record understandings of the term malfunction.	Establish a common understanding or definition of 'malfunction' across a range of contexts. Identify personal experiences of technology malfunction.	
	Predict what the future could have been like if a popular technological outcome had malfunctioned.	If this product had malfunctioned in the past, how would it have affected future technological outcomes and our lives? Examples might include: the flash drive, the laptop, antibiotics, post-it notes.	
Explain the cause/s of particular technological outcome malfunction	Pick an example of a technological malfunction (disaster): • What caused it? • What were the consequences for the ongoing development of the technology?	Current news clips of, for example, recalled products, airline disasters Many websites specialise in technology malfunctions, for example: • Google search 'recalled products NZ' for a list of current products • www.cpsc.gov/cpscpub/prerel/prerel.html • www.emints.org/ethemes/resources/S00001563.shtml	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: LEVEL 6

To support students to develop understanding of characteristics of technological outcomes at Level 6, teachers could:

- support students to discuss particular technological outcomes as a product and a system and support them to understand that the categorization of product or system is not an inherent property of the outcome, but rather how it is perceived by people in order to describe, and/or analyse it
- guide students to explore examples of socio-technological environments to explain how technological outcomes (products and systems) and non-technological entities and systems (people, natural environments, political systems etc.) interact together . Examples should be drawn from past, present and possible future socio-technological environments. Socio-technological environments include such things as communication networks, hospitals, transport systems, waste disposal, recreational parks, factories, power plant etc.
- support students to understand that interactions in socio-technological environments are complex and result in dynamic relationships between technological outcomes, entities and systems. Guide students to explore the influences and impact of these relationships on the way technological outcomes are developed and manufactured.

Indicators	Teaching Strategy	Explanation	Reflection
Explain why some technological outcomes can be described as both a product and a system	Provide a scaffold in the form of a diagram (graphic organizer) that shows a technological outcome, such as the iPod, as being described as both a system and a product.	Students diagrammatically identify the systems (and components of that system) that make up the product – for example, the iPod Extend the diagram out from single product to the supporting systems , such as iPod-iTunes store, music library, shareware, accessories – see store.apple.com/nz	
Describe socio-technological environments and the relationships of technological outcomes involved	Students explore how a technological outcomes interacts with the socio-technological environments where they are situated.	Predict the impact if the technological outcomes were located in different socio-technological environments.	
	Students identify historical cases where technological outcomes have impacted positively and where they have impacted negatively on the socio-technological environments where they were situated.	Identify the reasons for this impact (both positive and negative) and what could have been done to ensure that the impact was always positive.	
Discuss the interactions between technological outcomes, people, and social and physical environments within particular socio-technological environments	Students explore how people, and social and physical environments interact with technological outcomes, how these interactions make change within and between particular socio-technological.	Examples that could be explored include: personal music systems; sharing music/movies; recreational parks (Mahurangi, pest control gates). Students present their findings in a seminar to the class.	
Explain why understanding socio-technological environments allow technological outcomes to be better understood.	Students explore examples of where peoples understandings the socio-technological environment where a technological outcome was to be placed ensured that the outcomes was accepted into that environment.	Encourage students to explore both historical and contemporary examples.	
	Students explore examples of where peoples understandings the socio-technological environment where a technological outcome was to be placed prevented its eventual placement /acceptance within that environment.	Encourage students to explore both historical and contemporary examples.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: LEVEL 7

To support students to develop understanding of characteristics of technological outcomes at Level 7, teachers could:

- provide students with opportunities to discuss how malfunction can impact on the design or manufacturing of similar and related technological outcomes
- provide students with opportunities to identify that form refers to the physical nature of a technological outcome and function refers to the functional nature of the outcome. Design elements related to an outcome's physical nature include such things as: colour; movement; pattern; proportion; harmony; taste etc. Design elements related to an outcome's functional nature include such things as strength; durability; stability; efficiency; nutritional value etc. Design elements are prioritised in different ways as determined by such things as a designer's intent for the outcome, understandings of materials, the socio-cultural location the outcome is to be situated, professional and personal beliefs etc.
- support students to critically analyse the physical and functional nature of technological outcomes to identify how design elements appear to have been prioritised and to explain how such a priotisation could be justified
- support students to analyse the prioritisation of design elements in particular technological outcomes with respect to the intended purpose of the technological outcome, intended users and specific context, the wider socio-technological environment it was a part of, and the era of its development and to make informed judgments as to the outcome's fitness for purpose.

Indicators	Teaching Strategy	Explanation	Reflection
Explain how malfunction can impact on the design and/ or manufacture of similar and related technological outcomes	Find examples of where malfunction has lead to subsequent enhancement / modification of the outcome and/or similar outcome. e.g. baby buggy.	Give students an example of a badly designed outcome and a well designed outcome – for example, baby buggies –and identify the differences.	
	Teacher sourced examples of 'technological outcomes that have malfunctioned.	Teacher-led discussion about why these technological outcomes might have malfunctioned. Students in groups discuss how such malfunctions could have been prevented.	
Justify how the design elements appear to have been prioritised in technological outcomes.	Prioritisation of design elements.	Look at the iPod family and identify the design elements specific to each model and how the models differ in function. Which design elements were prioritised for each model and why. Source images of the iPod family. Devise a matrix that allows a clear comparison to be made/ shown between the individual products.	
Justify the fitness for purpose of technological outcomes in terms of their physical and functional nature and socio-technological environment/s they are used within	Students research a technological outcome that they are familiar with in order to justify it as being fit for purpose in terms of its physical and functional nature and socio-technological environment where it is used.	Students present justifications/ arguments in a seminar presentation to the class.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: LEVEL 8

To support students to develop understanding of characteristics of technological outcomes at Level 8, teachers could:

- provide students with opportunity to extend their understanding of fitness for purpose. This extended notion is called 'fitness for purpose in its broadest sense' and refers to the 'fitness' of the outcome itself as well as the practices used to develop the outcome (e.g. such things as the sustainability of resources used, ethical nature of testing practices, cultural appropriateness of trialing procedures, determination of lifecycle and ultimate disposal)
- support students to explore the implications of a commitment to developing technological outcomes that are fit for purpose in the broadest sense on the design, development and manufacturing of technological outcomes
- support students to critically analyse a range of technological outcomes to evaluate their fitness for purpose, in its broadest sense. The evaluation will be based on the physical and functional nature of the outcome, the historical, cultural, social, and geographical location of the final outcome as well as its development, and any information available regarding its performance over time
- support students to explore possible benefits and disadvantages of employing the notion of fitness for purpose in its broadest sense in different contexts related to the design and development, manufacture, evaluation and analysis of technological outcomes.

Indicators	Teaching Strategy	Explanation	Reflection
Discuss the implications of viewing fitness for purpose in its broadest sense on the design and development of technological outcomes	Develop criteria for evaluating fitness for purpose of a technological outcome the students are familiar with.	Either individually or collaboratively develop criteria for evaluating fitness for purpose that includes the physical and functional nature of the outcome as well as such things as: • the sustainability of resources used • the ethical nature of testing practices • the cultural appropriateness of trialing procedures • the determination of lifecycle and ultimate disposal. Test their criteria against the technological outcome.	
	Develop criteria for evaluating fitness for purpose of a technological outcome students are unfamiliar with.	As above.	
	View/listen to an engaging video/talk/guest speaker justify the fitness for purpose of a technological outcome they have developed, for example, 'The story of stuff'.	Students evaluate the justifications provided against the criteria they have developed above.	
Discuss the implications of viewing fitness for purpose in its broadest sense on the manufacture of technological outcomes	View/listen to an engaging video/talk/guest speaker justify the fitness for purpose of a technological outcome they have developed that has gone on to be manufactured.	Students evaluate the justifications provided by the technologist and discuss/debate with them the implications considered prior to and post the outcome being manufactured and released on the market.	
Justify the fitness for purpose, in its broadest sense, of technological outcomes	Students presenting justifications for the fitness for purpose, in its broadest sense, of a technological outcome they have developed.	Students present justifications/ argument in a seminar presentation to the class.	
Debate the value of employing the notion of 'fitness for purpose in its broadest sense' as related to: the design and development, manufacture, evaluation and analysis of technological outcomes.	Discuss examples where describing a technological outcome as fit for purpose in its broadest sense' is not appropriate.	Students explore examples where technological outcomes during its development phase can be justified as fit for purpose but in situ it has proven not to be the case. Students debate how this situation could have been avoided.	

TECHNOLOGICAL MODELLING

The examples of teaching strategies listed below are shown against specific curriculum levels. Many of these strategies listed however are appropriate at multiple curriculum levels. When selecting a strategy to address a specific learning need(s) of students, teachers are encouraged to look across the curriculum levels to identify the strategy(ies) that best matches the focused learning needs of their students and the context they have selected for learning in technology. For example where the focus for next student learning is on getting them to 'justify' rather than just 'explain' their decisions then the teaching strategy adopted will need to allow a focus on improving student abilities to 'justify'.

TECHNOLOGICAL MODELLING: LEVEL 1

To support students to develop understanding of technological modelling at Level 1, teachers could:

- provide students with the opportunity to discuss why technological modelling is important to the development of technological outcomes and that it involves both functional modelling and prototyping
- guide students to identify that functional models are representations of potential technological outcomes and that they exist in many forms (for example, thinking, talking, drawing, physical mock-ups, computer aided simulations etc)
- provide students with the opportunity to discuss that design concepts includes design ideas for parts of an outcome, as well as the conceptual design for the outcome as a whole
- provide students with the opportunity to interact with a variety of functional models and guide them to identify that the purpose of functional modelling is to test design concepts to see if they are suitable for use in the development of an outcome
- guide students to identify that prototypes are the first versions of fully completed technological outcomes
- provide students with a range of prototyping examples and guide them to identify that the purpose of prototyping is to test the outcome.`

Examples should include the modelling practices of technologists.

Indicators	Teaching Strategy	Explanation	Reflection
Describe what a functional model is	Define physical and functional attributes first (technological practice) before defining functional modelling.	Identify link between physical/functional attributes and functional modelling	
		Using a range of functional models discuss: • what they look like (physical appearance) • what they enable (function) in terms of design decision making.	
	Discuss examples of functional models.	Identify examples of functional models, such as drawings, talking, mockups, recipes. Create a class definition of a functional model and discuss why these help us when developing technological outcomes	
	What is a functional model?	Class discussion: • What is a model?/What is modelling?/What is technological modelling? Look at a product, such as a torch: • What did the technologist do to help them make this torch (such as drawings, model, test materials, circuit diagram, prototype)? • Why did they do these things? How did this modelling help them? Discuss images of the different forms of modelling • What is functional modelling? • What is prototyping? • What is the difference (eg,purpose)? Give students a everyday product they are familiar with (such as a stapler): • Which forms of modelling might have been used to create it? • What would it have told them? Class discussion: • What forms of technological modelling (such as draft drawings, final drawing, pattern) have been done for this outcome, and why were they done?	
Identify the purpose of functional modelling	Compare a range of functional models to prototypes.	Provide examples of prototypes (such as photos of prototype cars – Future for all) and examples of functional models (such as a sketch of car): • What is the difference? • What is similar? • Why have functional models? • Why have prototypes? • What is the purpose of both? Use a Venn Diagram to record differences and similarities.	
	Functional modelling of everyday items.	Share examples of functional modelling of everyday items (such as the bendy straw, or check out Google Patents): • Why did the technologist create this model? • What did it tell them? • How did it help them?	
Describe what a prototype is	Look at prototype products (such as cars and other products – see Future for all).	• What stage of production process is a prototype at? • Why is it at that stage? • What is the ext stage? • What information is gained from a prototype?	
Identify the purpose of prototyping	Share examples of prototypes of everyday items (such as the bendy straw, or check out Google Patents).	• Why did the technologist create this model? • What did it tell them? • How did it help them?	

TECHNOLOGICAL MODELLING: LEVEL 2

To support students to develop understanding of technological modelling at Level 2, teachers could:

- guide students to understand that design concepts refers to design ideas for parts of an outcome, as well as the conceptual design for the outcome as a whole
- provide students with the opportunity to explore a variety of functional models and identify the specific design concept/s being tested
- guide students to discuss the sorts of things that could be explored and tested using functional modelling
- provide students with a range of prototyping examples and guide them to identify the specifications that were used to evaluate the prototype.
- provide students with the opportunity to discuss how specifications provide a way of measuring the fitness for purpose of the prototype.

Examples should include the modelling practices of technologists.

Indicator	Teaching Strategy	Explanation	Reflection
Describe the sorts of things that functional modeling can be used for in technology	Discuss examples of functional models for a range of products	What information about physical nature does this model give me? What information about functional nature does this model give me? What was the purpose of this model? (testing physical attribute and/or functional attributes)	
	Provide students with examples of technological outcomes alongside possible forms (pictures /photos) of functional modelling	For example: Technological outcome = mobile phone. Functional modelling = drawings, circuit diagrams, mock ups. What can functional modelling be used for? Discuss how each functional model could be used: What information does it provide? – to test design ideas (parts of, for example, just buttons)? conceptual ideas (the whole)?	
Identify the design concept being tested in particular functional models	Explore functional modelling in the story of the development of a technological outcome.	Give students a story (Gadget Nation book is good) about a technological outcome and its development. What forms of functional modelling was done? They identify the design concepts being tested in the functional modelling done. Discuss both the functional models that were described in the story, as well as other forms of functional modelling that could/might have been done but weren't written about. They also describe the information the technologist gained from that functional modelling.	
Identify why prototyping is important in technology	Explore prototyping in the story of the development of a technological outcome.	Give students a story (Gadget Nation book is good) about a technological outcome and its development. What did the prototyping process tell them? What did it tell them about the outcomes fitness for purpose? Why is prototyping important?	
	Prototype products that have never gone into production – see Apple prototypes, www.theapplemuseum.com/index.php?id=45)	Show examples and discuss • What testing was/might have been done? • What did/could it have told them? • Why did it go no further? • Why is prototyping important?	
Identify the specifications used to evaluate particular prototypes.	Explore prototype products that have never gone into production – see Apple prototypes, www.theapplemuseum.com/index.php?id=45)	Show examples and discuss • What might have been the specifications for this product? • How was the prototype used to measure these specifications (such as testing of the prototype)? • What did/could this process have told them? • Why did it go no further? • What are the next steps?	

TECHNOLOGICAL MODELLING: LEVEL 3

To support students to develop understanding of technological modelling at Level 3, teachers could:

- provide students with the opportunity to explore different forms of functional modelling and guide students to gain insight into the different types of information that have been gathered
- provide students with the opportunity to discuss how functional modelling informs decision making and guide them to identify the benefits and limitations of functional modelling in examples provided
- provide students with the opportunity to understand that benefits include such things as reducing the risk of wasting time, money and materials and limitations arise due to the representational nature of modelling. That is, what is being tested is necessarily partial and therefore prototyping is required to fully test the outcome
- provide students with the opportunity to discuss that specifications include both acceptability and feasibility considerations related to the outcome's fitness for purpose
- provide students with the opportunity to explore a range of examples of prototyping and guide them to gain insight into how appropriate information can be gained to evaluate a technological outcome's fitness for purpose against the specifications
- provide students with the opportunity to discuss the role of functional modelling and prototyping to develop an understanding of the importance of both in technological development

Examples should include the modelling practices of technologists and should provide students with the opportunity to explore both successful prototypes and those that did not meet specifications

Indicators	Teaching Strategy	Explanation	Reflection
Discuss examples to identify the different forms of functional models that were used to gather specific information about the suitability of design concepts	Identify information gained from a model.	Have examples of different models (drawings, sketches, circuit diagrams, mock-ups, prototypes etc). What information does each give the technologist? Use in context with a certain technological outcome	
	Venn diagram of two types of models.	Venn diagram of two different forms of functional modeling – such as a drawing and a mock-up. Have students list the information each provides in the circles and the information both provide in the intersection of the circles.	
	Class brainstorm.	Class brainstorm about the different forms of functional modelling they used. For example: What information does our …………………… (model) give us and how can we use this to test and evaluate our design?	
	Estimate what modelling will provide, then reflect on actual findings.	For each form of modelling used, students estimate: • What information do I expect my model to allow me to test? Reflection: • What information did I actually get? • Did my model make me change anything? If so, why?	
	BMW modelling.	Watch video clip of functional modelling by BMW (YouTube link) and identify the forms of models in it (such as tape drawing, CAD, clay model): • What evidence or information did each form of modelling give them? • Why do they do these different forms of modelling?	
	Discuss how functional models and prototypes provide different evidence.	• Technology student website – modelling	
	Introduce and explore what CAD is, and discuss the kind of data it provides as a functional model.	• Technology student website – CAD	
	The form of modelling used needs to suit the technological outcomes.	Discuss with students why some forms of modelling are more suited that others to testing design ideas. For example: • A card mock-up will not be used to model a circuit • A drawing will not tell you about the weight of potential materials Have students suggest possible modelling techniques to test a specific desirable attribute in a technological outcome. Analyse an existing technological outcome and suggest what modelling forms would have been used to test the outcomes attributes during its development.	
	Matching game ; Match models with evidence they provide.	Cards with different models (sketches, descriptions, circuit diagrams, mock-ups, prototypes, etc). Cards describing different attributes tests (to test strength, safety, durability, aesthetics, fitness for purpose, etc). These cards can be words ("circuit diagram") or photos (photo of a circuit diagram) or pictures (the actual circuit /circuit diagram) or descriptions (the thinking/ talking). Students are required to match the model with the evidence it might provide, and justify their decisions.	
	Visiting technologist (or their story from Techlink).	Visiting technologist (or their story from Techlink) shares the modelling they have undertaken and how each model informed their decision-making. (Also see Gadget Nation activity above)	

Identify the benefits and limitations of functional modelling undertaken in particular examples	Explore functional modelling in the story of the development of a technological outcome.	Give students a story (Gadget Nation book is good) about a technological outcome and its development. Students identify: • the functional modelling that was done with that technological outcome. • the benefits and limitations of each model undertaken in this example • pros/cons of using the functional model.	
	Benefits and limitations of my own modeling.	For each form of modelling done or identified students ask: • What information does this model give me? • What information is missing? • In the future I would choose this model when I need to test for… • In the future I would not use this model when I need to test for…	
Describe examples of particular prototypes that did not meet specifications	Explore prototype products that have never gone into production (such as apple prototypes at www.theapplemuseum.com/index.php?id=45)	Show examples and discuss: • What might have been the specifications for this product? • How was the prototype used to measure these specifications (testing of the prototype)? • What did/could this process have told them? • Why did it go no further? • What could be the next steps?	
Explain why functional modelling and prototyping are both needed to support decision making when developing an outcome.	Visiting technologist (or their story from Techlink)	Visiting technologist (or their story from Techlink) shares the modelling they have undertaken and how each model informed their decision making. (Also see Gadget Nation activity above)	
	Venn diagram.	Using an example product or story of a products development, identify information gained from functional models and prototypes using a venn diagram. Explain what they have in common in terms of their purpose and the evidence they provide, and what they don't. This can highlight how they are both needed to support decision making.	
	Investigate product flops.	Read about a product that failed. Identify possible reasons why this product failed. How could technological modelling have lessened this product failure? Consider... • What functional models could have helped the technologist? • What information did the technologist not find out? • When were the key times when decisions were made? • What other testing or trialling could have been done? • How could prototyping have helped? • What technological modelling would be needed to re-launch this product?	

TECHNOLOGICAL MODELLING: LEVEL 4

To support students to develop understanding of technological modelling at Level 4, teachers could:

- provide students with the opportunity to explore how using different media influences the type of information that can be gathered
- provide students with the opportunity to discuss how different possibilities can be explored through functional modelling of design concepts and prototyping in order to make socially acceptable as well technically feasible decisions
- guide students to examine examples of functional modelling practices to identify how these were used to explore possibilities and gather different types of information to justify design decisions
- guide students to examine examples of prototyping and identify how information from these were used to justify the fitness for purpose of technological outcomes or to identify the need for further development

Examples should include the modelling practices of technologists and should include instances where refinements to the prototype were required to meet specifications.

Indicators	Teaching Strategy	Explanation	Reflection
Explain how functional modelling and prototyping allows for consideration of both what 'can' be done and what 'should' be done when making decisions	Student investigation of what they consider an unfavorable outcome.	Students investigate an existing technological outcome that they believe 'should not' have been made (weapons? nanotechnology? cell phones?), and present their justification as to why it 'should not' have been created. How can functional modelling and prototyping help a technologists ask: "Yes I can do it, but should I do it?"? At what stage within technological modeling should we ask this question? Link with alternative functions (Characteristics of Technological Outcomes). What about across different cultures? Class creates a bank of questions that need to/should be considered when developing a technological outcome. For example: • Who will use it? • How will it be used? • Who may be harmed if the outcome is developed and implemented? • Will any natural resources be depleted if the outcome is developed and implemented? • Who will benefit if the outcome is developed and implemented? • Who may be harmed if the outcome is developed and implemented?	
Discuss examples to illustrate how particular functional models were used to gather specific information about the suitability of design concepts	Visiting technologist (or their story from Techlink).	Example of a visiting technologist (or their story from Techlink) sharing the modelling they have undertaken and how each model informed their decision-making.	
Identify information that has been gathered from functional models about the suitability of design concepts and describe how this information was used	Weird or unsuccessful products that did not fully explore possibilities and different types of data.	Explore weird or unsuccessful products that did not do enough functional modelling before production. Did they fully explore all possibilities and issues prior to them being developed and implemented as technological outcomes? What information was gathered? What information did they not gather, but should have? How was that information used or not used? See, for example, McDonalds McDLT flop.	
Describe examples to illustrate how prototypes were tested to evaluate a technological outcome's fitness for purpose	Bad designs/ prototypes.	Find examples of bad designs/prototypes and discuss their intended fitness for purpose (Bad designs site). Students look at: • Why are these designs 'bad'? • How do they need refining? • How could earlier modelling have avoided these problems?	
		Read about a product that failed. Identify possible reasons why this product failed? How could technological modelling have lessened this product failure? • What functional models could have helped the technologist? • What information did the technologist not find out? • When were the key times when decisions were made? • What other testing or trialling could have been done? • How could prototyping have helped? • What technological modelling would be needed to re-launch this product?	
Identify information that has been gathered from prototyping and describe how this information was used.	Examples of prototype products (such as cars, potato peelers, hair dryer).	What information did prototyping provide? How did the technologist use that information? Are they fit for purpose? What do they need to be fit for purpose? (further development) How does a prototype help determine a products 'fitness for purpose'	

TECHNOLOGICAL MODELLING: LEVEL 5

To support students to develop understanding of technological modelling at Level 5, teachers could:

- provide opportunity for students to identify practical and functional reasoning underpinning technological modelling. Functional reasoning provides a basis for exploring the technical feasibility of the design concept and the realised outcome. That is, 'how to make it happen' in the functional modelling phase, and the reasoning behind 'how it is happening' in prototyping. Practical reasoning provides a basis for exploring acceptability (including socio-cultural and environmental dimensions) surrounding the design concept and realized outcome. That is, the reasoning around decisions as to 'should it happen?' in functional modelling and 'should it be happening?' in prototyping
- provide opportunity for students to explore how informed and justifiable design decision making relies on both functional and practical reasoning and draws from evidence provided from modelling
- guide students to analyse examples of functional modelling practices to explain how these were used to gain evidence to justify design decisions with regards to both technical feasibility and acceptability. Such justifications will rely on the synthesis of evidence gained from modelling that sought feedback from different stakeholders
- guide students to analyse examples of prototyping to explain how results were to used justify an outcome as fit for purpose or requiring refinement
- provide opportunity for students to understand that maintenance requirements can be identified through prototyping and guide them to identify that maintaining an outcome can involve controlling environmental influences and/or undertaking ongoing refinements of the technological outcome
- support students to gain insight from prototyping examples into how testing procedures can provide information regarding maintenance requirements of a technological outcome

Examples should include the modelling practices of technologists and should include instances where refinements to the prototype were required to meet specifications.

Indicators	Teaching Strategy	Explanation	Reflection
Identify examples of functional and practical reasoning within design decision making	Define evidence and reasoning.	Discuss and define what evidence is and what is reasoning. Brainstorm possible evidence and reasoning based on examples of functional modeling	
	Visiting technologists share stories about their functional modeling, or are related by teacher.	What modelling did they do? What evidence did they have prior to their functional modelling? What information did they find as a result of functional modelling? What reasoning process did they undertake? How did this affect their decision-making? What were the consequences for the final technological outcome once it was fully developed and implemented?	
Explain how evidence gained from functional modelling was used to justify design decisions	Visiting technologists share stories about their functional modeling, or are related by teacher.	www.youtube.com/watch?v=fBnSlHwESZU	
Identify examples of functional and practical reasoning underpinning prototype evaluations and the establishment of maintenance requirements	Examples of how prototypes can provide this information.	Explore examples of technological outcomes where a prototype did / could have informed the technologist of the maintenance requirements to ensure continued optimal performance over time. Use examples of products that have recently been recalled – such as seat belts in cars, baby buggy. Google 'product recall notifications NZ' to find examples of products that have been recalled.	
Explain how evidence gained from prototyping was used to justify outcome evaluation as fit for purpose or in need of further development.	Visiting technologist talks about prototyping.	Discuss how they use prototyping to test their technological outcomes in situ and provide evidence that the outcome is fit for purpose. Adidas Soccer Boot video – *Beyond 2000* television series.	
Explain how evidence gained from prototyping was used to justify outcome evaluation as fit for purpose or in need of further development.	Visiting technologist	Discuss how they use prototyping to test their technological outcomes in situ and provide evidence that the outcome is fit for purpose. Adidas Soccer Boot video – *Beyond 2000* television series.	

TECHNOLOGICAL MODELLING: LEVEL 6

To support students to develop understanding of technological modelling at Level 6, teachers could:

- guide students to explain how practical and functional reasoning underpin technological modelling. Functional reasoning provides a basis for exploring the technical feasibility of the design concept and the realized outcome. That is, 'how to make it happen' in the functional modelling phase, and the reasoning behind 'how it is happening' in prototyping. Practical reasoning provides a basis for exploring acceptability (including socio-cultural and environmental dimensions) surrounding the design concept and realized outcome. That is, the reasoning around decisions as to 'should it happen?' in functional modelling and 'should it be happening?' in prototyping
- guide students to understand the concept of risk as it relates to reducing instances of malfunctioning of technological outcomes, and/or increasing levels of outcome robustness
- guide students to understand how technological modelling is used to manage risk through exploring and identifying possible risk factors associated with the development of a technological outcome
- support students to analyse examples of technological modelling to understand how risk is explored and identified within particular technological developments

Examples should include the modelling practices of technologists and should include instances where modelling was undertaken to explore and identify risk.

Indicators	Teaching Strategy	Explanation	Reflection
Describe practical and functional reasoning and discuss how they work together to enhance decision making during technological modelling	Define practical and functional reasoning.	From the Techlink glossary: Functional reasoning focuses on 'how to make it happen' and 'how it is happening'. Practical reasoning focuses on 'should we make it happen?' and 'should it be happening? **Practical and functional reasoning** focuses the need to consider both what 'can' be done and what 'should' be done when making design decisions.	
	How do they work together to enhance decision making.	Introduce scenarios where only one was considered without the other and scenarios where they both worked together, for example, bombs, designer babies, genetic modifications. Explore notions of practical reasoning, scial responsibility, and environmental responsibility,	
Explain the role of technological modelling in the exploration and identification of possible risk/s	Technological product flops/disasters.	Take an example of a technological outcome that ultimately failed (such as the Titanic, Zeppelin). See Examples of products that flopped. Discuss possible technological modelling that might have been used and what risks they could have / didn't identify had modelling been used. • How could this disaster/product flop have been prevented? • What might have been the risks? • What technological modeling might have identified the risks?	
Discuss examples to illustrate how evidence and reasoning is used during functional modelling to identify risk and make informed and justifiable design decisions	Technological product flops/disasters.	Strengths and weaknesses of certain technological models for risk exploration Within a context (Titanic) or in general. Brainstorm to identify different forms of technological modelling (mock ups, drawings, circuit diagrams/software, prototypes, testing etc) that could help identify risks. Discuss the strengths and weaknesses of each modelling type in relation to the risk factors they could/might have been identified. How in-depth was the information that a technological model provided re a certain risk factor? (for example, a circuit diagram/software will identify the risks of components short circuiting, but testing of a prototype circuit would provide different information about other risks).	
Discuss examples to illustrate how prototyping provides information to determine maintenance requirements to ensure minimal risk and optimal performance over time	Visiting technologist.	Discuss how they use prototyping to determine maintenance requirements for an implemented technological outcome and ensure minimal risk and its optimal performance over time.	

TECHNOLOGICAL MODELLING: LEVEL 7

To support students to develop understanding of technological modelling at Level 7, teachers could:

- support students to explore how context impacts on the perception of the validity of evidence presented. Therefore, shifting from one context to another can change the status of the evidence provided by technological modelling
- support students to explore how and why different people and communities accept different types of evidence as valid. That is, the status given to evidence is dependent on a range of factors including ethical views and the perceived authority of people involved in the presentation of the evidence
- support students to understand how decisions underpinning technological modelling based on what should and could happen, rely on an understanding of how evidence gained may differ in value across contexts and/or communities
- support students to understand how technological modelling is used to ascertain and mitigate risk. Ascertaining risk involves establishing the probability of identified risks. Mitigation involves taking steps to reduce the probability of the risk being realised and/or severity of the risk should it be realised
- support students to analyse examples of technological modelling to understand how risk is ascertained and mitigated within particular technological developments.

Examples should include the modelling practices of technologists and should include instances where modelling was undertaken to mitigate risk.

Indicators	Teaching Strategy	Explanation	Reflection
Discuss examples to illustrate why the status of evidence gained from technological modelling might change across contexts	Status of evidence.	Explore how different technological developments (and their contexts) give different status to the evidence gained from their technological modelling. For example: The developers of an AS Colour T-shirt give more status to the evidence gained about environmental impact than the developers of low cost high profit T-shirt. www.ascolour.co.nz	
Explain why different people accept different types of evidence as valid and how this impacts on technological modelling	Differences in people.	Brainstorm: Why people view the same thing differently / interpret the same information in different ways? What makes one person accept something, when another rejects it? Think about: • different cultures • values • socio economic, • geography • religion • education • bias and prejudice. Explore examples of different forms of technological models/evidence and identify the advantages and disadvantages of each for identifying and mitigating risk, for example, a prototype car being testing in physical environment compared with a CAD representation of the same design. Explore how different people/groups (based on list above), may approach technological modelling and discuss the reasons for this, for example, an engineer, a food technologist, a packaging designer.	
Explain the role of technological modelling in ascertaining and mitigating risk		See Technological product flops/disasters activity in Level 6 above. Expand to focus on the role of technological modelling in ascertaining and mitigating risk.	
Describe examples to illustrate the strengths and weaknesses of technological modelling for risk mitigation		See Technological product flops/disasters activity in Level 6 above. Expand to focus on the risk mitigation, not just exploration.	

TECHNOLOGICAL MODELLING: LEVEL 8

To support students to develop understanding of technological modelling at Level 8, teachers could:

- support students to develop a critical and informed understanding of why technological modelling is an important aspect for ensuring responsible and defensible decisions are made during the design, development and any subsequent manufacturing of technological outcomes
- support students to critically analyse examples of technological modelling practices that were undertaken to address a range of competing and contestable factors to gain insight into how these factors can be handled. These factors arise from such things as differing moral, ethical, cultural, and/or political views and the way in which people adhere to and understand issues such as sustainability, globalisation, democracy, global warming etc.

Examples should include the modelling practices of technologists and should include instances where modelling was undertaken to deal with competing and contestable factors.

Indicators	Teaching Strategy	Explanation	Reflection
Explain the role of technological modelling in making informed, responsive and defensible design and development decisions	Visiting technologists or case studies about their functional modelling. Dragons' Den.	Students required to justify how their technological modelling allowed them to determine that their technological outcome was fit for purpose.	
Explain the role of technological modelling in making informed, responsive and defensible manufacturing decisions	Visiting technologists or case studies about their functional modelling.		
Discuss examples to illustrate a range of technological modelling practices that have been undertaken in situations with competing and contestable factors	Compare and contrast two technologists' practice or case studies.		
Critique examples of technological modelling practices in terms of how well they address underpinning factors.	Compare and critique two technologists' practice or case studies.		

TECHNOLOGICAL PRODUCTS

The examples of teaching strategies listed below are shown against specific curriculum levels. Many of these strategies listed however are appropriate at multiple curriculum levels. When selecting a strategy to address a specific learning need(s) of students, teachers are encouraged to look across the curriculum levels to identify the strategy(ies) that best matches the focused learning needs of their students and the context they have selected for learning in technology. For example where the focus for next student learning is on getting them to 'justify' rather than just 'explain' their decisions then the teaching strategy adopted will need to allow a focus on improving student abilities to 'justify'.

TECHNOLOGICAL PRODUCTS: LEVEL 1

To support students to develop understanding of technological products at Level 1, teachers could:

- provide students with a range of technological products and encourage them to explore these through such things as: using, 'playing', dismantling and rebuilding as appropriate
- guide students to identify the materials that the products explored are made from
- provide opportunity for students to discuss that performance properties of materials refer to such things as thermal and electrical conductivity, water resistance, texture, flexibility, colour etc.
- provide students with the opportunity to explore common materials and guide them to identify their performance properties
- provide students with a range of technological products to explore and guide them to identify ways in which materials have been manipulated to make the product. For example, in a wooden toy the wood has been shaped, sanded and painted; In a sandwich, the bread dough has been shaped, cooked and sliced; in a cushion the fabric has been cut and sewn together.

Indicators	Teaching Strategy	Explanation	Reflection
Identify materials that technological products are made from	Provide students with to examine a range of familiar articles (or photos of articles) made from different materials.	The teacher helps students identify: • the articles that are natural artifacts and those that are technological outcomes • the materials from which each are made.	
Identify performance properties of common materials	Provide students with a range of technological products they are familiar with (or photos of products) which are made from different materials. Identify the performance properties of those materials.	Brainstorm in groups/as a class: • Why are the products made from their component materials? • What are the performance properties of those materials? Collate findings and present as a wall chart with a photo of the product and the performance properties of the materials it is made from.	
Identify how the materials have been manipulated to make the product.	Identify parts of familiar technological outcomes (such as a pen, bike, chair) that have been shaped, joined and finished.	The teacher helps students to talk about why a particular material was chosen and how it has been shaped, joined finished (provide lots of examples). If possible pull the product to pieces and sort into parts that have been shaped, joined and finished.	

TECHNOLOGICAL PRODUCTS: LEVEL 2

To support students to develop understanding of technological products at Level 2, teachers could provide students with:

- guide students to understand that performance properties of materials refer to such things as thermal and electrical conductivity, water resistance, texture, flexibility, colour etc.
- provide students with the opportunity to research and experiment with a range of materials and guide them to describe how their performance properties relates to how they could be useful. For example, a material that was water and UV resistant, durable, and easily cleaned could be useful for outdoor furnishings
- provide students with the opportunity to research and experiment with a range of materials and guide them to describe how particular materials can be manipulated
- provide students with a variety of technological products to explore and encourage them to explore these through such things as: using, 'playing', dismantling and rebuilding as appropriate
- guide student to describe the relationship between the materials selected and their performance properties – for example, a school lunch box is made of plastic because plastic can be molded into different shapes, and is hard, durable, lightweight and easily cleaned..

Indicators	Teaching Strategy	Explanation	Reflection
Describe the performance properties of a range of materials and use these to suggest things the materials could be used for	Provide a range of familiar materials that students have used in the past and have them describe their performance properties.	Because they are using familiar materials, the students will have prior knowledge to work from. Use the identified performance properties to suggest other things these materials could be used for.	
	Introduce properties of materials and the correct terminology.	Technology student website – properties of materials	
	Provide a range of materials that students are unfamiliar with (haven't used in the past) and allow them to play with them to identify and describe their performance properties.	Students are introduced to simple sensory and physical tests such as: smell; feel; ability to bend, stretch compress; taste; texture; etc. Use these performance properties to suggest other things these materials could be used for.	
Describe feasible ways of manipulating a range of materials	Provide a range of materials that students are unfamiliar with (haven't used in the past) and allow them to play with them to identify feasible ways for them to be manipulated.	Teachers provide a range of tools – scissors, pliers, saws – and allow students (under instruction) to attempt to cut, bend and/or shape materials with them. Ask students to collate materials into those that can be bent, shaped, cut etc.	
Suggest why the materials used in particular technological products were selected	Provide a range of technological products that students are familiar with and have them describe the materials from which they are made and their performance properties. Why were these materials chosen for this product? (Limit products to ones that have only one or two materials, such as a potato peeler or a plastic toy).	Teachers need to choose the products carefully to give the students a range of materials to examine. Once again, move from the familiar to the unfamiliar, using products made from only one or two materials, such as a potato peeler, a screwdriver or a cutting board.	
	Provide a range of technological products that students haven't used/seen before and have them describe the materials and their expected performance properties. Why were these materials chosen for this product? (Limit products to ones that have only one or two materials.)		

TECHNOLOGICAL PRODUCTS: LEVEL 3

To support students to develop understanding of technological products at Level 3, teachers could:

- provide students with the opportunity to discuss that performance properties of materials can be measured objectively and subjectively. Subjective measurement is reliant on people's perception (tasty, evokes a sense of natural beauty, warm and inviting etc) where as objective measurement is not (conductivity, UV resistance etc). The fitness for purpose of a product relies on the material providing appropriate performance properties to ensure the product is technically feasible and acceptable (safe, ethical, environmentally friendly, economically viable, etc -as appropriate to particular products)
- provide students with a variety of technological products to explore and guide them to identify the performance properties of all the materials used, and to explain if these could be measured objectively or subjectively
- provide students with a variety of technological products and guide them to explain how properties combine to make the product both technically feasible and socially acceptable.

Indicators	Teaching Strategies	Explanation	Reflection
Describe the properties of materials used in particular products that can be measured objectively	Examine familiar and unfamiliar products (or photos of products) made from two or more materials, such as a pen, a pencil case or toy.	Students are asked to identify the materials the products are made from and their properties, identifying the properties that are common across materials and those that are different, and categorising them into those can be measured objectively and those subjectively.	
Describe the properties of materials used in particular products that can be measured subjectively			
Describe how the properties combine to ensure the materials allow the product to be technically feasible and socially acceptable	Examine familiar products (or photos of products) made from two or more materials, such as a pen, a clock or a watch.	Students examine a variety of products made from two or more materials (and, if possible, some that can be pulled apart). Working in pairs/groups, they are asked to determine: • What are the properties of the materials in this product? • How do the materials and/or properties contribute to the product being technically feasible (eg, function)? • How do the materials and/or properties contribute to the product being socially accepted?	

TECHNOLOGICAL PRODUCTS: LEVEL 4

Level 4

To support students to develop understanding of technological products at Level 4, teachers could:

- provide students with the opportunity to discuss what is meant by materials being formed, manipulated and transformed. Forming refers to bringing two or more materials together to formulate a new material resulting in a different overall composition and structure to that of the original materials. This results in different performance properties. For example: mixing flour, water and salt to make dough; mixing wood fibres, resin and wax to make MDF; glass fibre and a polymer resin combined to form fiberglass or fibre reinforced polymer (FRP). Manipulating materials refers to 'working' existing materials in ways that do not change their properties as their composition and structure is not altered. For example: cutting; molding; bending; jointing; gluing; painting. Transforming refers to changing the structure of an existing material to change some of its properties, but in terms of its composition, it remains the same material. For example: felting; beating an egg white; steaming timber to soften its fibres and allow it to be manipulated (bent)
- guide students to understand that for materials to be selected for use in a technological product, their particular performance properties must align with the desired specifications of that product
- guide students to recognise that during the development of a product, specifications are established that will require the manipulation, and in some cases, transformation and formation, of materials
- provide students with a variety of technological products to explore and guide students to identify examples of when materials needed to be manipulated, transformed and/or formed to enable material linked specifications of the product to be met and contribute to the product's fitness for purpose
- provide students with a scenario outlining technical and acceptability specifications for a product and support them to explore and research materials to determine what material would be suitable and how they could be manipulated and/or transformed to meet product specifications
- support students to communicate material related details effectively. Material related details include such things as what materials would be feasible and how they would need to be formulated, manipulated and/or transformed. Effective communication uses specialised language and symbols.

Focused Learning	Teaching Strategies	Explanation
Describe examples to illustrate how the manipulation of materials contributed to a product's fitness for purpose	Examine a range of products made from the same materials to discuss how and why the materials have been manipulated in the way that they have.	Students examine: • firstly products using the same materials – such as several products made from plastic • then products made from different materials – such as something made from plastic, something made from wood and something made from stainless steel.
	Examine a range of products made from different materials and discuss how and why the materials have been manipulated in the way that they have.	
	Examine a range of products that have more than one material and discuss how the materials work together to enable the product to be fit for purpose.	Allow students opportunity to play with the products and use them for their intended function. From this, encourage them to describe how the materials they are made from are joined allow the product to function. Suggest what would happen to the products' fitness for purpose if the materials they were made from were joined differently. For example, how fit for purpose would the product be if the materials were glued instead of being bolted together?
	Look at examples of how materials have been joined.	Technology student website – scroll down to joints
	Examine a range of products that have been finished in different ways and discuss: • the way they have been finished to enable the product to be fit the purpose • the benefits of them being finished in this way	Students look at a range of different surface finishes applied to materials used in a product and discuss how these finishes enable the product to be fit for purpose. Discuss what might happen to the product if the material was finished in a different way – for example, cardboard coated with wax would make it waterproof.
Describe examples to illustrate how the transformation of materials contributed to a product's fitness for purpose	Analyse existing products to identify the materials they are made from , how they were transformed to enable the product to achieve its physical and functional attributes.	Students analyse a range of existing products comprising two or three materials that have been moulded, shaped, bent, polished.
Describe examples to illustrate how the formulation of new materials contributed to a product's fitness for purpose	Analyse existing products to identify the materials they are made from , how they were transformed to enable the product to achieve its physical and functional attributes.	Students analyse a range of existing products made of formulated material(s), such as fibreglass, a cake, a brass tap.
Communicate, using specialised language and drawings, material related details that would allow others to create a product that meets both technical and acceptability specifications	Analyse existing working drawings, recipes to identify the symbols, language used to communicate technical information (including specifications) about materials/ingredients.	
	Students use specialised language and drawings to communicate information about a product. Other students required to make the product according to the information provided.	Students swap information and make each other's products.
	Students use specialised language and drawings to communicate information that describes an existing product (use a different product for each student).	When each student has completed a description for one product, mix the products and descriptions up and have students sort products to match the descriptions.

TECHNOLOGICAL PRODUCTS: LEVEL 5

To support students to develop understanding of technological products at Level 5, teachers could:

- guide students to understand that the composition of materials determines what performance properties it exhibits. Composition relates to such things as the type and arrangement of particles that make up the material
- support students to analyse examples of how materials have been selected to gain insight into how this selection relies on understanding the composition of the materials available and using this knowledge to help decide which materials in combination would provide the best 'fit' with the product specifications.

Examples should include the material selection practices of technologists.

Indicators	Teaching Strategies	Explanation	Reflection
Discuss examples to illustrate how the composition of materials determines performance properties	Students experiment with different ingredients to see what happens to the performance properties of materials when their composition is altered.	Examples could include: • over-tinting paint • adding additional salt/sugar to a recipe, when making, for example, a baked product • placing too much hardener in a resin/ glue • case-hardening a mild steel.	
Explain the link between specifications of a product and the selection of suitable materials for its construction	In groups look at a range of existing products related to the context they are working in.	Provide students with a range of products. In groups, they analyse what the product does (its proper function), its specifications, and the link with the properties of the materials that enable the product to do what it does.	
	Repeat the above with a much wider range of products that come from within and outside the context they are working in.	Students work in groups to undertake research and present back to the class – encourage students to use such things as PowerPoint and/or wall-charts to support their presentations.	
	Students choose a technological outcome they have made and do the same as above.		
	Deconstruct existing products.	Students analyse to determine: • the materials they are made from • the properties of those materials • the contribution the materials make to the overall performance specifications of each technological product	
Discuss examples to illustrate how decisions about material selection take into account the composition of the material and the specifications of the product	Group research task on material properties and composition.	Groups produce a poster on a given material that explains the material's composition and properties. The poster should include a product that uses that particular material, and: • list the materials and explain what that material is made up of. • explain the properties of the material, such as durability, colour etc • explain why these materials were selected in relation to their properties and composition.	
	Choose one product related to the context your working in, list the materials used and discuss how material selections were made.		
	Mix-and-match cards. Performance properties and material composition and properties.	Give students a range of different performance criteria for products and ask them to match the materials that meet the performance criteria.	

TECHNOLOGICAL PRODUCTS: LEVEL 6

To support students to develop understanding of technological products at Level 6, teachers could:

- provide students with the opportunity to research and experiment with a range of materials to develop understandings of how the composition and structure of materials impacts on how they can be manipulated and/or transformed, or combined to formulate a new material
- guide students to understand that material evaluation enables decisions to be made about how a material would support, or not, the fitness for purpose of particular technological products, and decrease the probability of a product malfunction
- support students to analyse examples of how materials have been evaluated to determine their suitability for use in particular technological products.

Examples should include the material evaluation practices of technologists.

Indicators	Teaching Strategies	Explanation	Reflection
Explain how the composition and structure of different materials enables them to be manipulated in specific ways	Bus-stop activity with a different material at each station.	Teacher provides a task activity set of instructions at each station that guides students to experiment with each material and answer questions on how that material can be manipulated. Take photos of what students did with each material.	
	Inquiry research question into one material, for example: How does the composition of material xxx affect its properties?	Students choose one of the materials they experimented with in the bus stop task and undertake research to explain the link between the composition of the selected material and its properties. Students report back to whole class or present a poster/PowerPoint presentation that explains their findings.	
	Pairs/group product analysis.	Students look at a range of technological products with different joining methods and different materials. Answer questions (teacher provided) that lead students to understanding that the composition of materials determines the way it can be joined.	
	Self-paced instructions requiring students to do a variety of joining methods.	Students are given range of instructional activities to work through at their own pace. Each activity outlines a jointing method with questions to evaluate the effectiveness of the joining method based on the composition of the materials and the application where the joint may be used.	
	Worksheet with different finishing options.	Students complete a worksheet that has a technological outcome with a number of different finishing options, which the students evaluate and discuss in terms of how these will affect the outcome's fitness for purpose.	
	Practical task of experimenting with different finishing options.	Provide students with a range of materials and finishing options and ask them to evaluate the effectiveness of each finishing option based on the composition of the material.	
	Research/homework task to investigate a finishing used on a selected technological outcome.	Students choose an outcome (a small/large, NZ/international technological product) and investigate what finishing options were used, how its choice was based on the composition of materials and how it affects the fitness for purpose of the outcome.	
	Research product recalls due to inappropriate finishing.	Students investigate sites such as the US Consumer Product safety Commission Product recall site to find examples of products that have been recalled due to inappropriate finishing – for example, www.cpsc.gov/cpscpub/prerel/prhtml09/09248.html Google-search 'products recalls NZ' to find recent examples.	
Explain how the composition and structure of materials determines the ways they can be transformed	Students experiment with a range of familiar and unfamiliar materials to determine how they can be transformed – use research and teacher-input to explain how the composition and structure of materials allows for this transformation.	Examples could include: • How wool can be transformed into textiles • The beating of egg whites to make a pavalova • Why some materials cannot be bent/shaped without first changing their physical characteristics – examples include: steaming wood; annealing ferrous and non ferrous metals; hardening a high-carbon steel.	
Explain how the composition and structure of materials impacts on how they can be combined to formulate a new material	Students explore a range of familiar and unfamiliar materials to determine how the composition and structure of the materials (ingredients) enabled the formulation of the material.	Students use research and teacher-input to inform explanations of how the composition and structure of these materials (ingredients) enabled the formulation of the material.	
	Research the development of new materials.		

Describe the role of material evaluation in determining material suitability for use in a technological product	In groups undertake material testing to determine a material's suitability for use in a technological outcome.	Students undertake a range of material tests to determine material performance properties and therefore its suitability for use in a technological outcome. Material performance properties that could be tested include: • tensile strength, compressive strength, sheer strength • crease resistance, malleability, drape, form, durability , absorbency • care and future maintenance • colour, texture, appearance, taste, sheen • chemical resistance.	
Discuss examples to illustrate how material evaluation informed the selection of materials in particular product development	A visiting technologist explains how they determine suitable materials for use in a product.		

TECHNOLOGICAL PRODUCTS: LEVEL 7

To support students to develop understanding of technological products at Level 7, teachers could:

- support students to understand that material evaluation enables decisions to be made about what material would be optimal to ensure the fitness for purpose of particular technological products
- support students to explore a range of subjective and objective evaluative procedures used to identify the suitability of materials for different uses
- support students to describe the underpinning concepts and processes related to subjective and objective evaluative procedures
- support students to understand the selection of appropriate material evaluation procedures relies on understanding the composition and structure of materials, how their properties can be enhanced through manipulation or transformation, the performance criteria required by technological products and an understanding of the physical and social context within which the technological product will be situated
- support students to identify and analyse examples of how materials have been evaluated to allow material selection decisions that maximize the potential fitness for purpose of particular technological products and to gain insight into how material evaluation procedures can be used to identify product maintenance and disposal implications and therefore inform design, development and post production care decisions.

Examples should include the material evaluation practices of technologists.

Indicators	Teaching Strategies	Explanation	Reflection
Discuss a range of subjective and objective evaluative procedures used to determine the suitability of materials and describe the underpinning concepts and processes involved in particular procedures	View YouTube videos of material testing.	Search for material testing video clips on YouTube.	
	Carry out material testing.	Within the limitations of the equipment available, carry out a range of material tests. Photograph and explain the findings.	
Discuss examples of material evaluation procedures undertaken to support material selection decisions and justify the appropriateness of these procedures	View YouTube videos of material testing.	Search for material testing video clips on YouTube.	
	Expert groups to research a given material test and present/ report back to class.	Investigate material testing that cannot be carried out in the classroom/workshop. Allocate a type of testing to each group with some focus questions. Each group undertakes the research and then presents their findings back to the class.	
Discuss examples to explain how material evaluation impacted on design and development decisions	Research task investigating a product designed for a particular environment/to perform a specific function.	Choose a product and the environment where it will be situated/used, such as: local daycare; beach; Antarctica. Investigate the environment where the outcome is situated and explain how the materials used in the product allow the product to function in the environment in which it is situated. Students need to see a range of products designed for different environments so that they identify the relationships between material properties and a product's fitness for purpose within its intended environment.	
Discuss examples to explain how material evaluation impacted on maintenance and disposal decisions	Task considering material selection in relation to maintenance and disposal issues.	Look at YouTube videos on issues to do with product disposal as starters, for example: • plastic water bottles or • www.thestoryofstuff.com Class discusses materials used in products. Including the: • implications for maintenance of the product due to the materials used • disposal implications for product once the product is past its used-by date.	

TECHNOLOGICAL PRODUCTS: LEVEL 8

To support students to develop understanding of technological products at Level 8, teachers could:

- support students to understand that material evaluation enables decisions to be made about what material would be optimal to ensure the fitness for purpose when taking into account both the technical feasibility and social acceptability of the product
- support students to critically analyse a range of subjective and objective evaluative procedures used to justify material suitability and to explain the underpinning concepts and processes involved in these procedures
- support students to understand why the selection of appropriate material evaluation procedures relies on understanding the composition and structure of materials, how their properties can be enhanced through manipulation or transformation, the performance criteria required by technological products and an understanding of the physical and social context within which the technological product will be situated
- support students to understand that the development of new materials relies on understanding: existing materials including their advantages and limitations; new material composition and structure possibilities; formulation procedures; future requirements, needs and desires; and an awareness that new evaluative procedures may need to be developed to determine the suitability of new materials
- support students to identify and analyse examples where new materials have been developed, including past and contemporary examples, to gain insight into how material formulation and subsequent evaluation procedures are used to address performance, maintenance and disposal implications and inform design and development decisions.

Examples should include material development (including formulation procedures) and evaluation practices of technologists.

Indicators	Teaching Strategies	Explanation	Reflection
Discuss examples of the formulation of new materials and explain the underpinning concepts and processes involved in their development	View a range of material innovations.	Teacher provides a range of material innovations for students to view. Ensure the range has both past and contemporary examples. Also ensure the range includes both new materials and existing materials used in a new way. For examples see: designinsite; YouTube	
	Research a material innovation.	Individually/pairs/groups research a materials innovation from a teacher provided list. Each student/group to look at one past and one contemporary example of material innovation. For a range of examples see: www.youtube.com/results?search_type=&search_query=material+innovation&aq=f	
Discuss examples of evaluation procedures undertaken to determine the suitability of new materials and explain the underpinning concepts and processes involved in particular evaluations	Teacher provides examples of material innovations for students to investigate.	Teacher provides photos of products using a material innovation, such as: carbon-fibre mast used on America's Cup yachts; bicycles; Marcel Wander's knotted chair. Students suggest the evaluation procedures that were used to determine the suitability of the material innovations used in the product and why these innovations were successful/nor successful.	
Discuss examples of past material developments and explain how these impacted on product design, development, manufacturing, maintenance and disposal	Teacher-led class discussion.	Teacher leads class discussion on past material innovations and explain how these impacted on subsequent technological development.	
	Research assignment.	Students choose a past material innovation and research how the innovation impacted on subsequent technological development.	
Discuss examples of contemporary material developments and suggest probable implications for future technological product design, development, manufacturing, maintenance and disposal	Individual research/presentation task.	Students choose a contemporary material innovation, research it, and make a presentation on probable implications for future technological product development.	

TECHNOLOGICAL SYSTEMS

The examples of teaching strategies listed below are shown against specific curriculum levels. Many of these strategies listed however are appropriate at multiple curriculum levels. When selecting a strategy to address a specific learning need(s) of students, teachers are encouraged to look across the curriculum levels to identify the strategy(ies) that best matches the focused learning needs of their students and the context they have selected for learning in technology. For example where the focus for next student learning is on getting them to 'justify' rather than just 'explain' their decisions then the teaching strategy adopted will need to allow a focus on improving student abilities to 'justify'.

TECHNOLOGICAL SYSTEMS: LEVEL 1

To support students to develop understanding of technological systems at Level 1, teachers could:

- provide students with a range of technological systems and encourage them to explore these through such things as: using, 'playing', dismantling and rebuilding as appropriate
- guide students to identify the components and how they are connected in the systems explored
- guide students to identify the inputs and outputs of technological systems and provide opportunity for them to recognise that a controlled transformation has occurred.

Indicators	Teaching Strategy	Explanation	Reflection
Identify the components of a technological system and how they are connected	Provide simple systems that students are familiar with (a simple mechanical toy, torch etc) and explore how the components are connected together.	Have students: • describe what they see when the system is complete in terms of how they think the components are connected • disassemble the systems to see how the individual parts are connected together. Use and encourage students to use technological language to describe components, and transformations, such as inputs, outputs, power, sound, receiver etc.	
Identify the input/s and output/s of particular technological systems	Provide simple systems that students are familiar with and talk about how the components work together from the input to the output.	Have students: • describe what they see when the system is complete in terms of the inputs and outputs • disassemble the systems to identify those components which are inputs and those outputs.	
Identify that a system transforms an input to an output	Provide simple systems that students are familiar with and talk about how the components work and the transformations that occur between inputs and output.	Have students: • describe the transformations that occur between the system's input and output.	

TECHNOLOGICAL SYSTEMS: LEVEL 2

To support students to develop understanding of technological systems at Level 2, teachers could:

- provide students with the opportunity to identify that simple technological systems are systems that have been designed to change inputs to outputs through a single transformation process
- provide students with a range of simple technological systems and encourage them to explore these through such things as: using, 'playing', dismantling and rebuilding as appropriate
- guide student to understand the role of each component and to identify the changes that are occurring in the transformation process
- guide students to understand that sometimes transformation processes may be difficult to determine or understand and these can be represented as a 'black box' – a black box is described as a way of depicting a part of a system where the inputs and outputs are known but the transformation process is not known.

Indicators	Teaching Strategy	Explanation	Reflection
Describe the change that has occurred to the input to produce the output in simple technological systems	Provide simple systems that students are familiar with and explore and identify what happens to make the change from input to output.	Teachers explain the changes in simple terms (flow chart?) using technological language to describe of component parts, for example, a simple mechanical toy, a hand-held egg-beater, a pasta maker.	
	Introduce non-electronic systems.	Technology student website - Mechanisms Technology student website -Gears and pulleys	
	Students arrange photographs of component parts of a simple system into sequence.		
Identify the role each component has in allowing the inputs to be transformed into outputs within simple technological systems	Students disassemble a simple system (like a torch) to identify each component and what it does.	Teachers assist students to make links to the technological products activities at Level 2 and use the appropriate descriptive language for systems.	

TECHNOLOGICAL SYSTEMS: LEVEL 3

To support students to develop understanding of technological systems at Level 3, teachers could:

- provide students with the opportunity to investigate a range of technological systems and guide them to understand that technological systems do not require further human design decision making during the transformation process for the inputs to be transformed to outputs. That is, a technological system will produce particular outputs in an automated fashion once the inputs have initiated the transformation process
- guide students to understand that a 'black box' is a term used to describe a part of a system where the inputs and outputs are known but the transformation process is not known
- provide examples of technological systems that contain unknown transformation processes (black boxes) and guide them to understand the role these play in terms of the advantages and/or disadvantages for developers and users
- provide opportunity for students to discuss that the fitness for purpose of a technological system relies on the selection of components, and how they are connected to ensure the system is technically feasible and acceptable (safe, ethical, environmentally friendly, economically viable, etc -as appropriate to particular systems)
- provide students with examples of how technological systems can be represented and guide students to interpret the specialised language and symbol conventions used
- provide students with opportunity to use specialised language and symbol conventions to represent technological systems to others.

Focused Learning	Teaching Strategy	Explanation	Reflection
Describe what 'black box' refers to within a technological system and the role of particular black boxes within technological systems	Students compare two systems, one with obvious components and one more hidden.	For example a torch and a cellphone. Explore what can be seen and explain and what is hidden or unknown. Teacher questions could be: • What is a system? • How does this system work? • Are there parts of the system that you don't know about or are hidden? • Why do you think that might be?	
	Introduce the term 'black box'.	Teacher supplies a range of technological systems. Identify: • the purpose of black boxing a system • the function the black box performs in the system (for a phone – transmitter sends the message, receiver accepts the message, etc)	
	Show pictures of technological systems that have parts that perform unknown transformation processes 'black-boxed'.	Using photographs of technological systems to capture students imagination, for example: ATM machine; Toy truck. Discuss as a class • Could the picture of the technological system be real? • How do you know that it is/is not real? • What tells us what the technology does? • What are the inputs and outputs of each system? • If what happens between the input and output(s) were black-boxed do you need to know what is happening?	
Identify possible advantages and disadvantages of having black boxed transformations within particular technological systems	Teachers use a PMI chart with students to identify possible advantages and disadvantages of black boxes in technology. Use a visiting technologist to talk about the concept of black boxes.	Discuss topics such as: • Do we need to know what's in the black box? • When would it be useful for you to know what's in the black box? • When is black boxing a system useful (an advantage)? • When is it not useful (a disadvantage)?	
Describe how the components, and how they are connected, allow particular systems to be technical feasible and socially acceptable	Students disassemble a simple systems to identify components they are made of, determine how they are connected and what each component does.	Teachers assist students to make links to the technological products activities at Level 2 and use the appropriate descriptive language to describe the systems components and connections.	
Describe particular technological systems using specialised language and symbol conventions	Draw flow chart using systems symbols and language to communicate a systems inputs transformation processes and outputs.		
	Match circuit component symbols with their symbols.	Technology student website • Basic circuit component symbols • More advanced circuit component symbols	
	Introduce resistor values. Calculate using resistor code posters, resistor colour wheels or online convertors.		

TECHNOLOGICAL SYSTEMS: LEVEL 4

To support students to develop understanding of technological systems at Level 4, teachers could:

- provide students with the opportunity to investigate a range of technological systems and guide them to identify how transformation processes are controlled
- support students to understand that control mechanisms can function to enhance the fitness for purpose of technological systems by maximising the desired outputs and minimising the undesirable outputs
- provide students with a scenario outlining technical and acceptability specifications for a system and support them to explore and research components and connectivity factors to determine what components would be suitable and how they could be connected to meet system specifications
- support students to communicate system related details effectively. System related details include such things as what components would be feasible, layout requirements, and how they would need to be connected. Effective communication uses specialised language and symbols.

Indicators	Teaching Strategy	Explanation	Reflection
Explain how transformation processes within a system are controlled	Use interactive videos from How Stuff Works. Focus on examples such as the thermostat on a heater, a tap (to control water).	Students to focus on identifying: • how the process is controlled • the purpose of the process.	
	Use basic circuits as examples of processes that are controlled to enable the inputs to be transformed to outputs	Technology student website – basic circuits	
Describe examples to illustrate how a technological system's fitness for purpose was enhanced by the use of control mechanisms.	Use interactive video from How Stuff Works to explore one of the following: electrical circuit and resistors, flow charts, thermostat on a heater, tap (to control water)	Students to focus on identifying how the control mechanism enhances the system's fitness for purpose.	
Communicate, using specialised language and drawings, system related details that would allow others to create a system that meets both technical and acceptability specifications.	Match circuit component symbols with their symbols	Technology student website – basic circuit component symbols Technology student website – more advanced circuit component symbols	
	Analyse others drawings to identify the conventions (symbols) used to communicate information about components and how they are connected	Circuit diagrams, mechanical systems, hydraulic and/or pneumatic systems.	
	Interpret system diagrams and describe: • what they do • what each component is (and its specifications) • how components are connected.		

TECHNOLOGICAL SYSTEMS: LEVEL 5

To support students to develop understanding of technological systems at Level 5, teachers could:

- guide students to understand that the properties of a subsystem relate to its transformation performance and its level of connective compatibility and that additional interface components may be required to ensure a subsystem can be effectively integrated into a system
- provide students with the opportunity to analyse a range of examples of complex technological systems that contain at least one subsystem. Complex technological systems are those designed to change inputs to outputs through more than one transformation process
- guide students to identify subsystems within technological systems and explain them in terms of their properties
- support students to use examples to gain insight into how the selection and interfacing of subsystems relies on understanding the transformation and connective properties of subsystems to ensure the best 'fit' with the required system specifications.

Examples should include the subsystem selection and interfacing practices of technologists..

Indicators	Teaching Strategy	Explanation	Reflection
Identify subsystems within technological systems and explain their transformation and connective properties	Using examples from How Stuff Works have students identify the subsystems in a tech system		
	Provide a range of everyday technological products/appliances that students can disassemble and identify the subsystems within them e.g. toasters, jugs, whiz sticks, laptops, phones etc.	Use examples from How Stuff Works to assist students to verify that they have identified the subsystems.	
Discuss how transformation and connection properties of subsystems impact on system layout and component selection	Students disassemble systems that contain subsystems (such as a phone, a toaster) to identify the subsystems and their components within them, how the subsystems connect with one another and what each subsystem does.		
Discuss examples to illustrate how interfaces take into account the connective compatibility between subsystems and other system components	Dismantle products/appliances to look at the connections the between subsystems that make up the product.	Students explain what they believe each subsystem does and how each connects with other subsystems to enable the product to function in the way that it does. Students draw a sequence/flow diagram to shows how the subsystems interface with each other. Students use *How Stuff Works* to verify/assist them with their explanations.	

TECHNOLOGICAL SYSTEMS: LEVEL 6

To support students to develop understanding of technological systems at Level 6, teachers could:

- guide students to understand the role subsystems play in the design, development and maintenance of complex technological systems. Complex technological systems are those designed to change inputs to outputs through more than one transformation process
- support students to indentify why subsystems may be 'black boxed' for development and/or maintenance purposes and guide them to understand how this can result in both advantages (reduced need to understand all aspects of the system, ability to replace faulty subsystem without disrupting the entire system) and disadvantages (trouble shooting can be difficult)
- guide students to understand how control and feedback at a system level allow 'back up' or 'shutdown' subsystems to be employed to reduce malfunction and/or component damage
- support students to analyse examples of how subsystems have been selected and used in particular complex technological systems
- support students to use examples to gain insight into how the use of subsystems can impact on system design, development and maintenance.

Examples should include system design, development and maintenance practices of technologists.

Indicators	Teaching Strategy	Explanation	Reflection
Explain the variety of roles played by subsystems in complex technological systems	Students disassemble complex technological systems that contain subsystems (such as a phone, a toaster) to identify the subsystems. and their components within them, and determine the role each subsystem plays within the overall technological system.		
	From system diagrams identify the subsystems and explain the role they play in relation to the overall function of the technological system.	Use existing diagrams of amplifiers, phones, power pack etc.	
Explain the implications of using subsystems during the design, development and maintenance of complex technological systems	Class discussion using a range of videos and/or other resources.	Find video clips showing the use of subsystems within a system, such as the ENIAC computer, or a module in a modern computer. Discuss the implications of using subsystems for the design, development, maintenance of technological systems.	
	Investigate a system the students have made themselves.	Either make or mock-up a system or use a system they have made previously. Identify the subsystems within the overall system. Explain: • the advantages of using subsystem at the design stage of a systems development • the implications of using the subsystem at the development (manufacturing) stage • the implications of using the subsystem at the maintenance stage.	
Describe examples to explain how control and feedback requirements impact on subsystem use	Class discussion on everyday examples of control/feedback systems.	Discuss a range of everyday systems using control/feedback. Discuss how the control/feedback works and how it allows self-regulatory technological systems to be achieved.	
	Worksheets.	Students provided with the diagrammatic representation of a range of systems. They are required to annotate the diagram showing which part of the system is providing the control and which the feedback.	
Discuss examples to illustrate the advantages and disadvantages of subsystems employed in particular technological systems	Case study of a selected technological system.	Students choose a system and research the advantages/disadvantages of having it designed around interconnected subsystems.	
	Teacher demonstration of a system.	Teacher sets up a system involving a number of subsystems. Students identify the advantages and disadvantages of being able to describe a system in terms of the subsystems that make it up.	
	Black box activity.	Teacher explains the concept of black boxes. Students use one of the systems looked at previously and discuss how parts of the system could be regarded as a black box.	

TECHNOLOGICAL SYSTEMS: LEVEL 7

To support students to develop understanding of technological systems at Level 7, teachers could:

- support students to understand the concepts of redundancy and reliability in relation to technological systems. Redundancy relates to the inclusion of additional components and/or subsystems to duplicate a function or functions. This duplication provides 'back-up' or allows for increased 'fail safe' tolerances. Reliability relates to the probability that a system will perform a required function under stated conditions for a stated period of time
- support students to identify and analyse a range of examples of technological systems to gain insight into how redundancy and reliability factors have impacted on system design, development and maintenance decisions.

Examples should include system design, development and maintenance practices of technologists.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain the concept of redundancy in relation to technological systems	Class discussion: What is redundancy?	Use examples found on the internet to illustrate the concept of 'redundancy' – for example, members within structures (bridge or can design). Establish a class definition for 'redundancy'. Using examples to illustrate points made, discuss advantages and disadvantages of redundancy in the design of development, and maintenance of technological systems.	
Discuss examples of particular technological systems to illustrate how factors related to redundancy impacted on system design, development, and/or maintenance decisions.	Case study of a chosen system.	Students select a system both within their own and other practice. Examine how redundancy has been incorporated into the system and how this has impacted on system design, development and maintenance.	
	Design Exercise to incorporate redundancy.	Teacher provides diagrams of a system that does not incorporate redundancy. Students design a way to incorporate redundancy.	
Explain the concept of reliability in relation to technological systems	Class discussion: What is reliability?	Use examples such as power supply to illustrate the idea of reliability. Reliability in technological systems refers to a system's ability to perform consistently and maintain its expected functions when operated within a specified manner. Students identify and describe other examples.	
Discuss examples of particular technological systems to illustrate how factors related to reliability impacted on system design, development, and/or maintenance decisions	Case study of a chosen system	Students select a system both within their own and other practice. Examine how reliability has been incorporated into the system and how this has impacted on system design, development and maintenance.	

TECHNOLOGICAL SYSTEMS: LEVEL 8

To support students to develop understanding of technological systems at Level 8, teachers could:

- support students to understand what operational parameters are and the role they play in the design, development and maintenance of technological systems. Operational parameters refer to the boundaries and/or conditions within which the system has been designed to function and are influenced by a number of factors associated with the technical feasibility and social acceptability of the system
- support students to identify and differentiate highly complex systems. Highly complex systems include self-regulatory and intelligent systems. Self regulatory systems are those that have been designed to adjust the functioning of transformation processes in response to feedback from any part of the system to produce desirable and known outputs. Intelligent systems have been designed to adapt to environmental inputs in ways that change the nature of the system components and/or transformation processes in known and unknown ways to produce desirable but unspecified outputs
- support students to identify and analyse a range of technological systems including simple, complex and highly complex technological systems
- support students to use examples to gain insight into underpinning operational parameters and how these have impacted on and been influenced by system design, development and maintenance decisions.

Examples should include system design, development and maintenance practices of technologists.

Indicators	Teaching Strategy	Explanation	Reflection
Explain what operational parameters are in relation to technological systems	Teacher-led discussion: What are operational parameters?	Operational parameters in technological systems define the tolerance range of a system's performance. This includes tolerances such as temperature variables, yield, energy consumption, waste and speed of operation. The role of operational parameters used in technological systems is to set limits around such things as: • energy use • level of waste • resource inputs • back up and fail-safe requirements • tolerances for outputs.	
Explain the operational parameters established for particular technological systems and explain the factors that influenced these	Site visit to a local production facility.	Students to identify the operational parameters of the system of production.	
	Research the operational parameters of a range of unfamiliar systems.	Conduct an internet research to find a range of systems (alarm system, irrigation system…) and describe the operational parameters. Students to discuss why they think these parameters are important to the functionality of the system.	
	Describe the concepts and processes of the operational parameters of a system the student has designed themselves.	Student analyse the operating principles in their own (or other) technological system.	
Discuss examples of technological systems to illustrate how operational parameters impacted on system design, development and maintenance	Practicing technologist perspective.	Guest talk from a system designer or use a Techlink case study (or similar) to identify the operating parameters that were established and how these impacted on the design, development and maintenance of a technological systems.	
Discuss examples of simple, complex and highly complex technological systems to illustrate the demands that increasing complexity in system design requires in terms of establishing operational parameters	Teacher led discussion on simple, complex and highly complex systems – for example, self-regulatory systems, intelligent systems.	Using the teachers own examples introduce and discuss simple, complex and highly complex systems – for example, self-regulatory systems, intelligent systems.	
	Research assignment.	Students choose a simple, complex and highly complex system, research it and explain how operational parameters have been developed to support the system.	