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

TECHNOLOGICAL MODELLING

The examples of teaching strategies listed below are shown against specific curriculum levels, although many are appropriate at multiple 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 ensure that the teaching strategy adopted enables a focus on improving student abilities to 'justify').

TECHNOLOGICAL MODELLING: SUPPORTING LEARNING ENVIRONMENT LEVEL 1

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

- guide students to understand that functional models are representations of potential technological outcomes and that they can take many forms (eg, thinking, talking, drawing, physical mock-ups, computer aided simulations etc)
- provide students with the opportunity to interact with a variety of functional models and guide them to identify that the common purpose of functional modelling is to test design concepts. Design concepts include design ideas for parts of an outcome as well as a complete conceptual design for the outcome as a whole
- guide students to understand that a prototype is the first version of the fully completed technological outcome
- provide students with a range of prototyping examples and guide them to identify that the common purpose of prototyping is to test the outcome.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Describe what a functional model is.	Define physical and functional attributes first (Technological practice) before defining functional modeling.	Identify link between physical/functional attributes and functional modeling.	
		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 or recipes. Create a class definition of a functional model and discuss why these help us when developing technological outcomes.	
Identify the purpose of functional modeling.	Compare a range of functional models to prototypes.	Provide examples of prototypes (eg, photos of prototype cars – see Future for all) and examples of functional models (eg, sketch of car), and ask: • What is the difference? • What is similar? • Why have functional models? • Why have prototypes? • What is the purpose of each? Use a Venn diagram to record differences and similarities.	
	Functional modeling of everyday items.	Share examples of functional modelling of everyday items (eg, bendy straw, check out Google Patents), and ask: • 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 (eg, cars – see Future for all).	• What stage of production process is a prototype at? • Why is it at that stage? Next stage? • What info is gained from a prototype?	
Identify the purpose of prototyping.	Compare functional models and prototypes.	Share examples of prototypes of everyday items (eg, bendy straw, check out Google Patents). • Why did the technologist create this model? • What did it tell them? • How did it help them?	

TECHNOLOGICAL MODELLING: SUPPORTING LEARNING ENVIRONMENT LEVEL 2

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

- provide students with the opportunity to interact with a variety of functional models and support them to identify the design concept being tested and if it related to the physical and/or functional nature of the potential outcome. Design concepts include design ideas for parts of an outcome as well as a complete conceptual design for the outcome as a whole.
- provide students with examples of evaluations from prototyping and support them to identify whether the technological outcome tested was fit for purpose.
- guide students to reflect on the role of functional modelling and prototyping to develop an understanding of the importance of both in technological development.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain that the purpose of functional modelling of design ideas allows for the gathering of specific information about the possible nature of a potential technological outcome.	Provide examples of functional models for a range of products.	Students encouraged to answer the following questions: • 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)?	
Describe examples to illustrate how functional modelling has been used to test design ideas and develop conceptual ideas.	Provide examples of technological outcomes alongside examples (pictures /photos) of its functional modeling.	Students could look at, for example, the mobile phone as a technological outcome, and its drawings, circuit diagrams, mock-ups as functional modelling, and discuss how each functional model was used to test design ideas (parts of, eg, just buttons) conceptual ideas (the whole).	
Describe examples to illustrate how prototyping has been used to test technological outcomes.	Prototype products that have never gone into production.	Show examples and discuss: • What testing was/might have been done? • What did/could it have told them? • Why did it go no further?	
Discuss the importance of functional modelling and prototype testing in the development of technological outcomes.	Examples of modelling in a technological outcomes story of development.	Give students a story (Gadget Nation book is good) about a technological outcome and its development. They identify the functional modelling that was done with that technological outcome and also identify other modelling that could/might have been done. They also describe the information the technologist gained from that functional modelling.	*I have found this activity to be very good with Year 8 students. It is a good introduction to modelling. Students were able to identify the actual modelling done, but also could imagine other possible modelling that could/ might have been done. They could describe the information gained from each examples of functional modelling in the story and how these different models help the technologist in different ways. – Cliff Harwood*

TECHNOLOGICAL MODELLING: SUPPORTING LEARNING ENVIRONMENT LEVEL 3

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

- provide students with the opportunity to explore a range of examples of functional modelling and support students to gain insight into the different types of evidence that can be generated and to explore the impact that the media used can have on the way evidence is generated.
- support student discussion of how functional modelling informs decision-making and guide them to identify the benefits and limitations of functional modelling in examples provided. Benefits include such things as reducing the risk of wasting time, money and materials. 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 explore a range of examples of prototyping to gain insight into how appropriate evidence can be gained to evaluate a technological outcome's fitness for purpose and establish if there is a need for any further development.

Focused Learning (Indicators)	Teaching Strategy	Explanation	Modification/ Reflection
Explain that different forms of modelling provide different types of evidence.	Identify information gained from a model.	Students are shown examples of different models (eg, drawings, sketches, circuit diagrams, mock-ups, prototypes), and asked: What information does each give the technologist? Use in context with a particular technological outcome.	
	Discuss how physical mockups and prototypes provide different evidence than functional models.	Technology student website – modelling	
	The form of modelling used needs to suit the technological outcomes.	Discuss with students why some forms of modelling are more suited than others to testing design ideas. For example: • a card mockup 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 techniques would have been used to test the outcomes attributes during its development.	
	Matching game – Match models with evidence students provide.	Students are given cards with different models (eg, sketches, descriptions, circuit diagrams, mock-ups, prototypes) and cards describing different attributes tests (eg, to test strength, safety, durability, aesthetics, fitness for purpose). These cards can be of words ("circuit diagram") or photos (photo of a circuit diagram) or pictures (the actual circuit /circuit diagram) or descriptions (the thinking/talking). Students are asked to match the model with the evidence it might provide, and to justify their decisions.	
Discuss examples to illustrate how particular models were developed to gather specific data to inform decision-making.	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.	Provide examples of modelling in the development of a technological outcome(s).	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 • the pros/cons of using the functional model.	
Describe examples to illustrate how prototypes were tested to evaluate a technological outcome's fitness for purpose and to identify any need for further development.	Provide examples of prototype products (eg, cars, potato peelers, hair dryer.	Ask students: • 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: SUPPORTING LEARNING ENVIRONMENT LEVEL

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

- support student discussion about the importance of using modelling to explore whether an outcome should be developed as well as whether it could be developed.
- support students to examine examples of extensive and diverse functional modelling practices used to support particular technological developments – both within their own and other's technological practice.
- guide students to gain insight into how design decisions are justified with regards to both feasibility and acceptability. Such justifications will rely on the synthesis of evidence gained from diverse forms of modelling seeking multiple perspectives.
- support students to identify and examine examples of prototyping from both within their own and other's technological practices
- support students to gain insight from examples of how evidence gained can be used to justify an evaluation of a technological outcome's fitness for purpose or its requirement for further development.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain why it is necessary to consider both what 'can' be done and what 'should' be done when making design 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 'shouldn't' have been created. Students could: • answer the question: At what model/stage of development did/should the technologists have asked "Yes I can do it, but should I do it?"possibly link with alternative functions, eg, 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?	
Explain why different forms of functional modelling are needed to fully explore possibilities and different types of data.	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. This meant that all possibilities and issues were not fully explored before they were developed and implemented as technological outcomes (eg, McDonalds McDLT flop).	
	Introduce and explore what CAD is and discuss what kind of data it provides as a functional model.	Technology student website – CAD	
Discuss examples of prototyping to explain how evidence gathered provided justification for evaluating a technological outcome as fit for purpose or in need of refinement.	Bad designs/prototypes.	Students find examples of bad designs/prototypes and discuss their intended fitness for purpose (Bad designs site). Students to look at: • Why are these designs 'bad'? • How do they need refining? • How could earlier modelling have avoided these problems?	
	Weird or unsuccessful products where the prototyping stage could have provided information about fitness for purpose.	Weird or unsuccessful products where the prototyping stage could have provided info re fitness for purpose. This meant that they did not fully explore all possibilities and issues prior to them being developed and implemented as technological outcomes (eg, McDonalds McDLT flop).	

TECHNOLOGICAL MODELLING: SUPPORTING LEARNING ENVIRONMENT LEVEL 5

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

- ensure students understand that informed and justifiable decision-making relies on reasoning and evidence.
- support students to examine examples of extensive and diverse functional modelling practices used to support particular technological developments – both within their own and other's technological practice.
- support students to gain insight from examples into how design decisions are justified with regards to both feasibility and acceptability. Such justifications will rely on the synthesis of evidence gained from diverse forms of modelling seeking multiple perspectives.
- support students to identify and examine examples of prototyping from both within their own and other technological practice.
- support students to gain insight from examples into how testing procedures can provide information regarding maintenance requirements of a technological outcome. Maintenance requirements involve addressing environmental influences on, and/or ongoing refinements of, the technological outcome.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Discuss examples to illustrate how evidence and reasoning is used in informed and justifiable decision-making during functional modelling	Define evidence and reasoning.	Sudents discuss and define what evidence is and what is reasoning, brainstorming possible evidence and reasoning based on examples of functional modeling.	
	Visiting technologists explains their use of functional modeling.	The visiting technologist to answer questions such as: • 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?	
Discuss examples to illustrate how prototyping provides information to determine maintenance requirements to ensure optimal performance over time.	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, baby buggies. Google-search 'product recall notifications NZ' to find examples of local products that have been recalled.	

TECHNOLOGICAL MODELLING: SUPPORTING LEARNING ENVIRONMENT LEVEL 6

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

- 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.
- support students to examine examples of technological modelling to understand how risk is explored and identified within particular technological developments.
- guide students to understand practical and functional reasoning.
- guide students to understand how functional and practical reasoning influences technological modelling particularly in terms of identifying the focus for testing and the interpretation of evidence.
- 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.
- ensure students examine their own technological modelling as well as technological modelling undertaken by a other technologists

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain practical and functional reasoning and how they work together to enhance technological modeling.	Define practical and functional reasoning.	From 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.	Introduce scenarios where only one aspect (practical or functional reasoning) was considered without the other and scenarios where they both worked together, for example: bombs, designer babies, genetic modifications. Explore notions of practical reasoning – social responsibility, 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 (eg, Titanic, Hindenburg). 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?	
Describe examples to illustrate the strengths and weaknesses of technological modelling for risk exploration.	Technological product flops/disasters.	Students explore strengths and weaknesses of certain technological models for risk exploration Within a context (eg, Titanic) or in general. Students brainstorm to identify different forms of technological modelling (eg, mock up, drawings, circuit diagram/software, prototype, testing) and brainstorm potential risk-factors. Students discuss 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 concerning a certain risk factor? (eg, a circuit diagram/software will identify the risks of components short circuiting, but testing of a prototype circuit would provide different information re other risks).	
	Modelling an example.	Present the class with a hypothetical example of the development of a technological outcome (eg, bridge, electronic alarm, chair). Students brainstorm all the risk factors that need to identified/mitigated for the technological outcome both during its development and prior to it being implemented as a product. Each student/group does a different technological model (eg, mock up, drawings, circuit diagram/software), and feeds back to class on the risk factors that the model highlighted. What risk factors were not explored? What other technological modelling might need to be undertaken?	

TECHNOLOGICAL MODELLING: SUPPORTING LEARNING ENVIRONMENT LEVEL 7

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

- support students to understand that 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 the context impacts on how valid evidence is perceived to be. This means that shifting from one context to another can change the status of the evidence provided by technological modelling.
- 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 examine examples of technological modelling to understand how risk is ascertained and mitigated within technological developments.
- ensure students examine their own technological modelling as well as a technological modelling undertaken by a range of technologists.

Focused Learning	Teaching Strategy	Explanation	Modification/ Reflection
Explain why different people accept different types of evidence as valid.	Differences in people.	Brainstorm: • Why do people view the same thing differently/interpret the same information in different ways? • What makes one person accept something, when another rejects it, in terms of factors such as: different cultures; values; socioeconomic; 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, eg, a prototype car being testing in physical environment compared with a the CAD representation of that design. Explore how different people/groups (based on list above, such as an engineer, food technologist, packaging designer) may approach technological modelling and discuss the reasons for this.	
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 a AS Colour T-shirt give more status to the evidence gained about environmental impact than the developers of low cost high profit T-shirt – see www.ascolour.co.nz.	
Explain the influences on decision-making underpinning technological modelling that ensures both what 'should' and 'could' be done are fully explored and justified.	Role-playing on the theme of Influences: Aspects of the technological development	Influences on decision-making can be based on: context; needs/opportunities; stakeholder; attributes/specifications Discuss the following questions, both in general and in the context of an outcome (either student's own outcome or an example such as a new motorway): • What contributes to the decisions about what "should" and "could" be done? • How can these influences be explored? • How can decisions made be justified against these influences? Students each given a role to play in a scenario for the development of a controversial outcome (eg, new motorway, intersection layout, sports stadium). Roles: different stakeholders (both positive and negative); governments (local and central; road designers; park management; contractors; rate payer. Ask the questions again, and have the group discuss, this time representing the interests of their role.	
	Role-playing on the theme of Influences: Differing moral, ethical, cultural, and/or political views	Discuss the following questions, both in general and in the context of an outcome (either their own outcome or another example, eg, designer babies, nanotechnology, stem cell research) • What contributes to the decisions about what 'should' and 'could' be done? • How can these influences be explored? • How can decisions made be justified against these influences? Influences on decision-making can be: ; different cultures/ethnicities; values; socio-economic; geography; religion; education; political; bias and prejudice. Students are each given a role to play in a scenario of the development of a controversial outcome (eg, designer babies, stem cell research). Roles could be based on list above. Ask the questions again, and have the group discuss, this time representing the interests of their role.	

Explain the role of technological modelling in ascertaining and mitigating risk.		See risk examples above Expand on these 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 risk examples above Expand on these to focus on the risk mitigation, not just exploration.	

TECHNOLOGICAL MODELLING: SUPPORTING LEARNING ENVIRONMENT 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 technological development
- ensure students examine examples of technological modelling that involve 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.
- ensure students examine their own technological modelling as well as a technological modelling undertaken by a range of technologists.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain the critical role of technological modelling in making informed, responsive and defensible design and development decisions within technological developments.		See role play activity above Expand on this to focus on: • What makes the modelling critical? • How can people be informed? • What is responsive design? • How do/can you defend your design? Record (video/audio) the role play and analyse.	
Describe examples to illustrate how technological modelling has allowed for justifiable and defensible technological practice that takes account of often competing and contestable factors.		See role play activity above Expand on this to focus on … • What are the competing and contestable factors? Record (video/audio) the role play and analyse.	

TECHNOLOGICAL PRODUCTS

The examples of teaching strategies listed below are shown against specific curriculum levels, although many are appropriate at multiple levels. When selecting a strategy to address specific learning needs of students, teachers are encouraged to look across the curriculum levels to identify the best strategy(ies) for those learning needs in the context they have selected for learning in Technology. For example, if the focus for student learning is on getting students to 'justify' rather than just 'explain' their decisions, make sure the teaching strategy adopted enables a focus on improving student abilities to 'justify'.

TECHNOLOGICAL PRODUCTS: SUPPORTING LEARNING ENVIRONMENT LEVEL 1

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

- provide students with a range of technological products to explore and guide them to identify the materials they are made from.
- provide students with the opportunity to explore common materials and guide them to determine what they can do and how they can be manipulated.
- guide students to use knowledge of materials to suggest why a material would be selected for use in a particular product, and how it has been shaped, joined and/or finished to make the product.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Identify materials that technological products are made from.	Provide students with a range of familiar articles (or photos of articles) made from different materials to examine.	Have students identify (with teacher input): • those articles that are natural artifacts and those which are technological outcomes • the materials from which each are made.	
Suggest why the materials used in particular technological products were selected.	Provide students with a range of technological products they are familiar with (or photos of products) which are made from different materials.	Brainstorm in groups/as a class, why the products are made from the materials that they are. Collate findings and present as a wall chart with a photo of the product and a description of the materials they are made from.	
Identify that materials have been shaped, joined and/or finished to make a technological product.	Identify parts of familiar technological outcomes (such as a pen, bike, chair) that have been shaped, joined and finished.	Teachers help the 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: SUPPORTING LEARNING ENVIRONMENT LEVEL 2

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

- the opportunity to research and experiment with a range of materials and guide them to identify their performance properties. Performance properties of materials refer to such things as conductivity, water resistance, warmth, texture, flexibility, etc.
- a variety of technological products and guide them to identify the performance properties particular materials provides for that product.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Describe the performance properties of particular materials.	Provide a range of familiar materials that students have used in the past and have them describe their performance properties.	By using familiar materials here, the students will have prior knowledge to work from.	
	Introduce properties of materials and the correct terminology.	Resource: 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.	Introduce students to simple sensory and physical tests such as smell; feel; ability to bend, stretch compress; taste; texture etc.	
Identify the performance properties of materials used in particular technological products	Provide a range technological products that students are familiar with and have them describe the materials they are made from and their performance properties. (Limit products to ones that have only one or two materials, such as a potato peeler, 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, screwdriver, 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. (Limit products to ones that have only one or two materials)		

TECHNOLOGICAL PRODUCTS: SUPPORTING LEARNING ENVIRONMENT LEVEL 3

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

- provide students with the opportunity to research and experiment with a range of materials and support students to develop understandings of why materials have particular performance properties. These understandings will be based on the combination of a material's structural (conductive, ductile etc) and sensory (colour, texture etc) qualities.
- provide students with a variety of technological products and support them to investigate how the materials used in the product combine to allow the product to function as designed.
- provide students with a range of technological products with unknown functions and support them to make informed suggestions for possible function.

Focused Learning	Teaching Strategies	Explanation	Modification/Reflection
Identify the structural and sensory qualities of particular materials and how these combine to provide the performance properties of the materials.	Allow students to interact with materials that are familiar and unfamiliar to them in order to explore and describe about their particular performance properties.	Choose materials carefully to give the students a wide range of material examples. Use games such as Taboo or Headbanz. Give the opportunity for students to describe materials and for others to determine the material that is being described	
Explain how all the materials used in a technological product work together to allow the product to function as designed.	Examine familiar products (or photos of products) made from two or more materials, (such as a pen, a clock or watch, etc).	Working in pairs/groups, students are to determine: • what the proper function of the product is • how the materials contribute to the product's function. Choose a variety of products for students to examine (and if possible have some that can be pulled apart).	
Suggest possible functions of a technological product based on an understanding of the materials used in its construction.	Examine unfamiliar products or photos of products with more than two materials.		

TECHNOLOGICAL PRODUCTS: SUPPORTING LEARNING ENVIRONMENT LEVEL 4

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

- provide students with the opportunity to research and experiment with a range of materials and support students to develop understandings of how materials have been formed, manipulated and/or transformed in ways to enhance the fitness for purpose of particular technological products over time.
- ensure students understand that 'forming' refers to how materials can be shaped (cut, moulded, bent, carved etc) to the 'form' required for use in the product, and manipulating and transforming refers to how materials can be joined and/or 'finished' in ways that change their performance properties.

Focused Learning	Teaching Strategies	Explanation	Modification/Reflection
Describe examples to illustrate how a technological product's fitness for purpose was enhanced by the way a material was shaped.	Examine a range of products made from the same materials to discuss how/why the materials have been formed, manipulated and/or transformed in the way that they have.	Move from products using the same materials, (such as several products made from plastic) to those 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/why the materials have been formed, manipulated and/or transformed in the way that they have.		
Describe examples to illustrate how a technological product's fitness for purpose was enhanced by the way a material was joined with other materials.	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.	Give students the opportunity to play with the products and use them for their intended function. From this, encourage them to describe how the why 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 together instead of being bolted together?	
	Look at examples of how materials have been joined.	Technology student website – scroll down to joints.	
Describe examples to illustrate how a technological product's fitness for purpose was enhanced by the way a material was finished.	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 – eg, cardboard coated with wax to make waterproof.	

TECHNOLOGICAL PRODUCTS: SUPPORTING LEARNING ENVIRONMENT LEVEL 5

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

- support students to examine examples of how materials have been selected to ensure the fitness for purpose of particular technological products – both within their own and other's technological practice.
- support students to use examples to gain insight into how selecting an appropriate material relies on understanding the composition of materials. The composition of materials relates to such things as the type and arrangements of particles that make up the material.
- ensure students understand that for materials to be selected for use in a technological product, their particular performance properties must align with the desired performance specifications of that product.

Focused Learning	Teaching Strategies	Explanation	Modification/Reflection
Describe examples to illustrate how the performance specifications of technological products determine the performance properties required of materials that might be suitable for the product's 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) and the properties of the materials which enable the product to achieve this.	
	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, wall charts to support their presentations.	
	Students choose a technological outcome they have made and do the same as above.		
	Deconstruct existing products	Analyse to determine: materials they are made from properties of the material contribution the materials make to the overall performance specifications of technological products	
Discuss examples to illustrate how decisions about material selection take into account the composition of the material.	Group research task on material properties and composition.	Groups produce a poster on a given material that explains the materials 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: SUPPORTING LEARNING ENVIRONMENT 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 their chemical composition impacts on how they can be formed, manipulated and/or transformed.
- ensure students understand that materials can be formed, manipulated and/or transformed to enhance the fitness for purpose of a technological product. 'Forming' refers to how materials are shaped (cut, molded, bent etc) to the 'form' required for use in the product. Manipulating and transforming refers to how materials are joined and/or finished in ways that change their performance properties.
- support students to examine examples of how materials have been evaluated to ensure the fitness for purpose of particular technological products – both within their own and other's technological practice.
- support students to use examples to gain insight into how material evaluation procedures rely on understanding the composition of the materials to be evaluated and the performance criteria of a technological product.
- ensure students 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.

Focused Learning	Teaching Strategies	Explanation	Modification/Reflection
Explain how the composition of different materials enables them to be shaped in different ways	Bus stop activity with a different material at each station.	Provide 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 formed, manipulated and/or transformed. Take photos of what they did with each material.	
	Pose an 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 to report back to whole class or present a poster/PowerPoint presentation that explains findings.	
Explain how the composition of materials determines the way it can be joined.	Pairs/groups product analysis.	Students examine a range of technological products with different joining methods and different materials, and answer questions (teacher-provided) that lead them to the 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.	Provide a range of instructional activities that students work through at their own pace. Each activity outlines a jointing method with questions to evaluate its effectiveness based on the composition of the materials and the application where the joint may be used.	
Explain how the composition of materials determine the types of 'finishing' techniques suitable for use.	Worksheet with different finishing options.	Provide a worksheet that has the same technological outcome but with a number of different finishing options. Students evaluate the different finishing options and how these will affect the outcomes 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 (small/large, NZ/international technological product) and investigate the finishing options used, how this 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 research 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, such as www.cpsc.gov/cpscpub/prerel/prhtml09/09248.html Google search 'products recalls NZ' to find local examples.	
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.	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.	

TECHNOLOGICAL PRODUCTS: SUPPORTING LEARNING ENVIRONMENT LEVEL 7

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

- support students to identify and examine examples of how materials have been evaluated to allow material selection decisions that maximise the potential fitness for purpose of particular technological products.
- ensure students 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.
- ensure students understand that concepts and processes employed in evaluating a material are related to the composition, the required performance properties of the material and an understanding of the context within which the technological product will be situated.
- support students to use examples to gain insight into how material evaluation procedures can be used to identify maintenance and disposal implications and inform design and development decisions.

Focused Learning	Teaching Strategies	Explanation	Modification/Reflection
Explain the concepts and processes that underpin the evaluation of a particular material.	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.	
	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.	
	Task considering material selection in relation to maintenance and disposal issues.	Search for YouTube videos on issues to do with product disposal as starters, such as plastic water bottles, or visit www.thestoryofstuff.com Class discusses teh 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.	
Describe examples to illustrate how materials have been evaluated to determine their suitability for specific products and the environments in which they are situated.	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 products fitness for purpose within its intended environment.	

TECHNOLOGICAL PRODUCTS: SUPPORTING LEARNING ENVIRONMENT LEVEL 8

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

- support students to identify and examine examples of material innovation including past and contemporary examples.
- ensure students understand that material innovation can refer to both the development of a new material, or the use of an existing material in a 'new' way.
- support students to use examples to gain insight into how material innovation and evaluation procedures are used to address performance, maintenance and disposal implications and inform design and development decisions.
- support students to understand the implications for the evaluation of innovative materials whereby new procedures may need to be developed and codes established.
- ensure students understand that material evaluation enables decisions to be made about how a material would support, or not, the fitness for purpose in of particular technological products.
- ensure students understand that concepts and processes employed in material innovation and evaluation are related to composition, the required performance properties of the material and an understanding of the context within which the technological product will be situated.

Focused Learning	Teaching Strategies	Explanation	Modification/Reflection
Explain the concepts and processes that underpin an identified material innovation and its evaluation.	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, and also includes both new materials and existing materials used in a new way. For examples see: *Internet* You Tube	
	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	
Describe examples to illustrate how material innovations have been evaluated to determine their suitability for specific products and the environments in which they are situated.	Teacher provides examples of material innovations for students to investigate.	Teacher provides photos of products using a material innovation, such as the carbon-fibre mast used on the America's Cup Yacht, bicycles, or Marcel Wander's knotted chair. Students suggest what evaluations were used to determine the suitability of the material innovation that were used in that product and whether and why these innovations were successful or not.	
Discuss examples of past material innovations and explain how these impacted on subsequent technological development.	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 innovations and suggest probable implications for future technological product development.	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, although many are appropriate at multiple 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 ensure that the teaching strategy adopted enables a focus on improving student abilities to 'justify').

TECHNOLOGICAL SYSTEMS: SUPPORTING LEARNING ENVIRONMENT LEVEL 1

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

- provide students with a range of technological systems to explore and guide them to identify system components and how they are connected.
- guide students to identify the inputs and outputs of technological systems and recognise that a controlled transformation has occurred.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Identify the components of a technological system and how they are connected.	Provide simple systems that students are familiar with (eg, a simple mechanical toy) and explore how the components that make it up 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 different parts are connected together. Consistently use, and encourage students to use, technological language to describe components, and transformations, eg, inputs, outputs, sound, receiver.	
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 the components that are inputs and those are 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: SUPPORTING LEARNING ENVIRONMENT LEVEL 2

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

- provide students with a range of simple technological systems to explore and guide them to understand the role of each component and to identify the changes that are occurring in the transformation process. Simple technological systems are defined as systems that have been designed to change inputs to outputs through a single 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 a way of depicting a part of a system where the inputs and outputs are known but the transformation process is not known.

Focused Learning	Teaching Strategy	Explanation	Modification/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 (eg, flow chart) using technological language to describe component parts of, eg, a simple mechanical toy, hand egg-beater or 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 pen) 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: SUPPORTING LEARNING ENVIRONMENT 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.
- provide examples of technological systems that contain unknown transformation processes (black boxes) and support students to understand the role these play in terms of the advantages and/or disadvantages for developers and users.
- 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	Modification/Reflection
Describe what a 'black box' is within a technological system.	Students compare two systems, one that has obvious components and one where the components are more hidden.	An example could be a torch and a cell phone. Students explore what they can see 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 they might be?	
	Introduce the term 'black box'.	Teacher supplies a range of technological systems that do not require intervention to transform their inputs into outputs. Identify: • the purpose of a black box system • the function the black box performs in the system (eg, in a phone the transmitter sends the message, receiver accepts the message).	
	Show pictures of black box technologies. See: • Petrol pump • Cigarette machine • ATM machine • Toy truck	Discuss as a class • Could this be real? • How do you know? • If it were a black box, do you need to know what is happening? • What tells us what this black box system does? • Advantages and disadvantages of a 'black box'?	
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 box? • When would it be useful for you to know what's in the box? • When is black boxing a system useful (an advantage)? • When is it not useful (a disadvantage)?	
Describe technological systems using specialised language and symbol conventions.	Draw a flow chart using systems symbols and language to communicate a system's inputs, transformation processes and outputs.		
	Match circuit component symbols with their symbols.	Technology student website – basic circuit component symbols Technology student website – more advanced circuit component symbols	
	Introduce resistor values. Calculate using resistor code posters, resistor colour wheels or online convertors.		

TECHNOLOGICAL SYSTEMS: SUPPORTING LEARNING ENVIRONMENT 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 support them to identify how transformation processes are controlled
- support students to understand that control mechanisms can work to in ways to enhance the fitness for purpose of technological systems by maximising the desired outputs and minimising the undesirable outputs.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain how processes are controlled to enable the inputs to be transformed to outputs.	Use the interactive video from How Stuff Works, focusing on examples such as the thermostat on a heater and 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 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: an electrical circuit and resistors; flow charts; a thermostat on a heater; or a tap (to control water).	Students to focus on identifying how the control mechanism enhances the system's fitness for purpose.	

TECHNOLOGICAL SYSTEMS: SUPPORTING LEARNING ENVIRONMENT LEVEL 5

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

- provide students with the opportunity to investigate a range of technological systems that contain one or more subsystems both from within their own and other's technological practice.
- support students to identify subsystems within technological systems and describe them in terms of their properties. The property of a subsystem refers to the role it provides in the technological system as a whole and can be established by examining what has happened to the input to become the output at the subsystem stage.
- support students to understand that interfaces between subsystems have an important role in enabling the technological system to work effectively as a whole.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Identify subsystems within technological systems and explain their properties.	Using examples from How Stuff Works have students identify the subsystems in a product.		
	Provide a range of everyday technological products/appliances that students can disassemble and identify the subsystems within them, eg, 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 examples to illustrate how interfaces between subsystems support the way the technological system works.	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 they connect with other subsystems to enable the product to function in the way that it does. Students draw a sequence/flow diagram to show how the subsystems interface with each other. Students use How Stuff Works to verify/ assist them with their explanations.	

TECHNOLOGICAL SYSTEMS: SUPPORTING LEARNING ENVIRONMENT LEVEL 6

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

- provide students with the opportunity to investigate a range of technological systems that contain one or more subsystems both from within their own and other's technological practice.
- support students to use examples to gain insight into how the use of subsystems can impact on system design, development and maintenance particularly in relation to the development of self-regulatory systems.
- support students to understand that subsystems can allow the design of complex technological systems where some subsystems are 'black boxed' for development and or maintenance purposes. This can result in both advantages (eg, reduced need to understand all aspects of the system, ability to replace faulty subsystem without disrupting the entire system) and disadvantages (eg, trouble-shooting can be difficult).
- support students to understand the role of subsystems in reducing malfunction and/or system componentry damage through such things as 'back up' or 'shutdown' subsystems.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain the implications of using subsystems, for the design, development and maintenance of technological systems.	Class discussion using a range of videos and/or other resources.	Find video clips showing the use of subsystems within a system, eg, ENIAC computer, or a module in a modern computer. Discuss the implications of using subsystems for the design, development and maintenance of technological systems.	
	Investigate a system the students have made themselves.	Either make or mock-up a system or use a system that students 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.	
Describes examples to illustrate how control and/or feedback subsystems allows for the design of self-regulatory technological systems.	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 a self-regulatory technological system to be achieved.	
	Worksheets.	Provide students with the diagrammatic representation of a range of systems. Ask them to annotate the diagram showing what parts of the system provide the control and the feedback.	
Describe 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 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: SUPPORTING LEARNING ENVIRONMENT LEVEL 7

Supporting Learning Environment Level 7

- To support students to develop understanding of technological systems at Level 7, teachers could:
- support students to identify and examine a range of technological systems both from within their own and other technological practice.
- support students to understand the concepts of redundancy and reliability.
- support students to use examples to gain insight into issues associated with how redundancy and reliability have impacted on system design, development and maintenance.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain the concept of redundancy and the implications for the design, development, and maintenance of technological systems.	Class discussion: What is redundancy?	Use examples from the internet to illustrate the concept of 'redundancy', such as the members within structures of, for example, a bridge. 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.	
	Case study of a chosen system.	Students select a system both within their own practice and from the practice of others. 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 and the implications for the design, development and maintenance of 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.	
	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: SUPPORTING LEARNING ENVIRONMENT LEVEL 8

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

- support students to identify and examine a range of technological systems both from within their own and other technological practice.
- support students to understand operational parameters and the role these play in the design, development and maintenance of technological systems.
- support students to use examples to gain insight into operational parameters and explore how they influence and impact on system design, development and maintenance.
- support students to understand the difference between self-regulatory systems and intelligent systems. 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.
- provide students with the opportunity to investigate intelligent technological systems and support student to understand how the operational parameters enable these systems to function.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain the concepts and processes underpinning the operational parameters of particular technological systems.	Teacher led discussion: What are operational parameters?	Operational parameters in a technological system define the tolerance range of a system's performance. This includes tolerances such as temperature variables, yield, energy consumption, waste and speed of operation. Operational parameters set limits around such things as: • energy use • level of waste • resource inputs • back-up and fail-safe requirements • tolerances for outputs.	
	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.	Students conduct an internet research to find a range of systems (alarm system, irrigation system, etc) 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.	Student analyse the operating principles in their own (or another) technological system.	
Explain how the establishment of operational parameters impact on the design, development and maintenance of technological systems.	A practicing technologist's perspective.	Arrange a talk from a system designer or use Techlink case study (or similar) to help students identify the operating parameters that were established and how these impacted on the design, development and maintenance of the technological system.	
Discuss examples of self-regulatory and/or intelligent systems and explain how operational parameters have been developed to support such systems	Teacher led discussion on self-regulatory and/or intelligent systems	Using the teacher's own examples introduce and discuss self-regulatory and/or intelligent systems.	
	Research assignment.	Students choose a self-regulatory and/or intelligent system, research it and explain how operational parameters have been developed to support the system.	

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: SUPPORTING LEARNING ENVIRONMENT LEVEL 1

To support students to undertake outcome development and evaluation at level one 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.
- 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	Modification/Reflection
Describe potential outcomes, through drawing, models and or verbally.	Directed conversations about possible design ideas.	Teacher provides guided discussion questions for students to follow in relation to developing a possible outcome. 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? Draw everyday objects without worrying too much about the artistic value. Concentrate students on identifying design features, eg, labeling parts and indicating materials and possibly some overall measurement of these objects. No erasers to be used in the first instance – if students want to change something they have drawn then encourage them to use another colour.	
	Introduce the language of outcomes (eg, mock up, model, prototype). Introduce the concepts of: PSSD (purposeful silent sustained drawing/ design). Progressive Dictionary (as a class tool) 'I have…/Who has…'	Common terminology – graphic and written description. I have something that you can … (eg, tell the time with). Who has … ?	
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. For example: We (the students in this class) need something to put our felts and pencils in at school. It needs to be … (attributes relevant to kids). Provide students with examples of possible products that would resolve the need, for example: overnight bag; plastic bag; sunglasses case; pencil case – metal and fabric drinking glass.	Explore the products to determine if they meet the brief. Describe what needs to be changed to allow the product to meet the brief. Discuss why the products would or would not be suitable for holding the felts and pencils.	
	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 have been through to develop their outcome.	Encourage students to evaluate each stage of the process as to whether it allowed the outcome to meet the identified attributes.	

OUTCOME DEVELOPMENT AND EVALUATION: SUPPORTING LEARNING ENVIRONMENT LEVEL 2

To support students to undertake outcome development and evaluation at level two 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.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Describe potential outcomes through drawing, models and or verbally	Describe conceptual ideas graphically using 2D and 3D drawings, verbally, through modelling media, eg, plasticine, clay, paper, coroflute, kitchen boxes/tubes.	Encourage students to use a range of media/modes to describe their ideas. Provide isometric paper to assist students when drawing in 3D.	
Evaluate potential outcomes in terms of identified attributes to select the outcome to produce	Evaluate a range of given concept ideas (someone else's) against given attributes to identify which ones provides 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 scones. At end of the lesson, discuss with them how the scones attributes would need to change if the person eating these were: • diabetic • obese • gluten-intolerant (celiac). Use a PMI chart to evaluate models of potential outcomes. Develop a rubric to evaluate models or conceptual ideas 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, eg, carrying school equipment to school, portable seat. Ask students to describe a conceptual design that would meet their determined attributes.	
	Trialing of materials is always context dependent – examples of tests that students can be taught include: strength testing, waterproofing, taste testing, preserving, conservation of heat/energy etc.	Provide opportunities for trialing of materials prior to application in development of outcome. (Do not just trial and then say: "You have to use this … ".)	
Produce an outcome in keeping with the brief	Use the BP Technology Challenges to develop understandings about required attributes. This could be done on a regular monthly/weekly basis.	Use the BP Technology Challenges as the context for producing a quick outcome that needs to meet a desired set of attributes. Reinforce to students that these are isolated activities and are not technology in its entirety and not necessarily following a good technological practice model. (This activity also provides a link with aspects associated with technological modelling – particularly the construction skills and also the testing of a conceptual design.)	
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 particular attributes of the brief.	Students present their final outcome and describe how it addresses the need or opportunity. The rest of the class (or a selected group of evaluators from the class) provide feedback as to whether the presented outcome meets the attributes identified as necessary for a technological outcome to be fit for purpose in resolving the need/opportunity.	

OUTCOME DEVELOPMENT AND EVALUATION: SUPPORTING LEARNING ENVIRONMENT LEVEL 3

To support students to undertake outcome development and evaluation at level three teachers could:

- establishes an environment that encourages and supports student innovation.
- establishes the need or opportunity and defines the conceptual statement through negotiation with the students.
- guides students to identify attributes for an appropriate outcome.
- structures students' Technological Practice through a series of linked learning experiences (both pre-planned and responsive) to provide opportunity for knowledge and skill development, and encourage student trialing and refinement of skills and understandings.
- provides a selection of resources, to support students to develop their outcome.
- provides students with an overview of the key stages they will undertake during their Technological Practice

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Develop (through research and functional modelling) conceptual ideas that communicate possible outcomes that incorporate identified key attributes and address the need or opportunity.	Use the Student Showcase or Case Studies on the Techlink website to illustrate different ways in which other students have communicated possible outcomes – undertake a comparative analysis to identify any differences and determine the ways that effectively communicate and that are not so effective in terms of communication.	Use photographs and or mock-ups/models of technological outcomes - analyse these against the key attributes that allowed the outcome to address the need/opportunity. Deconstruction - explore existing technological outcomes to identify key attributes, construction techniques, aesthetics etc. Model aspects of a technological outcome using sketches, mockups/models to develop student understandings of different communication techniques.	
Trial materials for the development of an outcome.	Test materials to determine their suitability for use in a specific context – have students provide justifications as to whether the materials are suitable or not.	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 (e.g. 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.	
Carry out technological modelling to evaluate the outcomes ability to address the need or opportunity.	Provide students with opportunities to make mockup of aspects of, or models of the entire technological outcome – evaluate these against the attributes determined as essential for the outcome to address the need/ opportunity.	Focus not just on the selection of a model that enables the potential of the concept to be tested but also on the modelling techniques used to create it so that the tests carried will allow the potential of the concept to be effectively determined.	
	Provide a selection of technological models/mockups of varies design ideas for a technological outcome – have students test these against desired attributes to determine the potential of the idea to address aspects of the need/opportunity.	Provide students with a variety of technological models/mockups – 2D, 3D physical models, graphical representations with descriptions, virtual models, descriptions only of the outcome.	
Develop an outcome that addresses the need or opportunity.	Analyse the technological practice undertaken by others when developing a technological 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.	
Evaluate their final outcome against the key attributes in terms of it addressing the need or opportunity.	Peers evaluate a technological outcome against the attributes it was developed to meet.	Provide students with a range of technological outcomes and the briefs that they were developed to address – have students evaluate them to determine if they address the intended need or opportunity.	

OUTCOME DEVELOPMENT AND EVALUATION: SUPPORTING LEARNING ENVIRONMENT LEVEL 4

To support students to undertake outcome development and evaluation at level four 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 modeling.
- provide a range of materials/components and the opportunity to develop the necessary knowledge and skills to test and use them guide students to evaluate outcomes in situ against key attributes.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Describe design ideas (either through drawing, models and/ or verbally) or potential outcomes.	This is an opportunity to teach a range of skills related to communicate ideas such as drawing, context-specific vocabulary and construction skills. For example: • Rapid Viz, crating, 2D/3D • Necker cubes – for an explanation see mathworld.wolfram.com/NeckerCube.htm • use of annotations to explain drawings • graphics techniques (Technology student website – graphics).	Resources can be broken down into those used for: Concept design generation (eg, research tools, concept screening tools Testing concept ideas to determine their potential to be fit for purpose Manufacturing/realising the technological outcome. See: www.betterbydesign.org.nz	
Undertake functional modelling to develop design ideas that address the key attributes.	Analyse past students' best practice and or teacher resources of best practice in developing technological outcomes, including: • the functional modelling they undertook to test the potential fitness for purpose of conceptual ideas • identifying how they selected suitable materials, • their means of sourcing materials.	Use portfolios of previous students practice, student mentoring and/or case studies on the Techlink website. Provide a range of existing solutions for students to analyse. Videos or DVDs that show modelling in practice, for example: • www.betterbydesign.org.nz Google search: product design modelling videos • Technology student website – modelling	
Evaluate suitability of materials/ components, based on their performance properties, to select those appropriate for use in the production of a feasible outcome.	Develop students' domain-specific skills in working materials to realise a technological outcome. Focus on skills used to manipulate (cut, shape, join) and finish materials.	Conduct a series of skill related activities focused on enhancing student knowledge of and abilities to work with materials.	
	Explore the limitations of the performance properties of material/components.	Conduct controlled testing of materials/ components against criteria to find their physical limits (to the point of failure). Use worksheets with focused questions. Show videos that demonstrate applications of materials such as: • Megastructures website • Water cube website	
	Analyse past student practice to identify how they ensured that their outcome was meeting the key attributes identified as important to address the need or opportunity.	Use portfolios of previous student practice and/or case studies on the Techlink website.	
Produce and trial a prototype of the technological outcome.	Develop a generic set of criteria, (supplemented by students' own criteria), that come from the final brief and specifications. These can be used to determine a functional models suitability to test the potential fitness for purpose of a technological outcome and/or its component part(s).	Use portfolios of previous student practice and/or case studies on the Techlink website.	
	Analyse past student practice in using functional models to test, evaluate and refine potential outcomes.	Use existing student solutions link this to other examples of how to rapid prototype – see www.YouTube.com/watch?v=PDLOmoQj4H0&feature=fvst.	
	Series of photographs demonstrating modelling and production stages that were undertaken which lead to a developed prototype.	See: www.techlink.org.nz/Case-studies/Classroom-practice/Materials/CP819-Focus-on-Modelling/index.htm	

Evaluate the fitness for purpose of the final outcome (prototype) 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.	
	Peers evaluate their or other developed outcomes against the attributes they were developed to meet.	Provide students with a range of technological outcomes and the briefs used in their development. Have students evaluate them to determine if they address the intended need or opportunity. Each student has the post-it notes that they can make one comment on for each and attach it to the student's work.	
	Dragons Den type round robin discussion.	Use a group brief and ask students to talk about how their outcome meets particular attributes of 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 and share their interpretations to identify those that are similar and those which are different. Discuss why any such differences occurred.	

OUTCOME DEVELOPMENT AND EVALUATION: SUPPORTING LEARNING ENVIRONMENT LEVEL 5

To support students to undertake outcome development and evaluation at level five 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 modeling.

provide a range of materials/components and the opportunity to develop the necessary knowledge and skills to test and use them

guide students to evaluate outcomes in situ against brief specifications.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Generate design ideas that are informed by research and analysis of existing outcomes.	Analyse past students practice used in developing technological outcomes including the functional modelling they undertook to test the potential feasibility (fitness for purpose) of their conceptual ideas.	Use portfolios of previous students practice and/or case studies off the Techlink website.	
	Students analysis and compare existing products related to their design ideas.	Technology student website – product comparisons	
	Determining that attributes that influenced the design of existing technological outcomes.	Using a range of related technological outcomes (eg, sound making devices, potato peelers, cellphones), have students individually write what they perceive the attributes are for one of them. Students test their attributes at stations where other students can comment/add to the attributes they identified. Treat as a 'bus stop' activity.	
	Suggest additional design features and the attributes for these that the existing technological outcomes could have if their existing attributes were to be extended.	Insist that the additional attributes need to be informed by and enhance already existing attributes that the outcomes possesses.	
	Teach visual communication techniques.	Enhance student abilities to visually communicate their ideas using such resources as: • Rapid Viz techniques • Photoshop • Google SketchUp • Crocodile Clips • Inspiration	
Undertake functional modelling to develop design ideas that address the specifications.	Analyse past students practice used in developing technological outcomes, including the functional modelling they undertook to test the potential fitness for purpose of conceptual ideas and how they determined material suitability.	Use portfolios of student practice and/or case studies from the Techlink website.	
	Develop students modelling techniques to: test conceptual ideas communicate conceptual ideas. Have students identify the advantages and limitation of each technique.	Students investigate models, mockups, testing and trialing techniques that enable communication and testing of conceptual ideas: physical models – construction and testing techniques virtual models (use of 3D modelling programmes).	
	Enhance student skills in /means of communicating conceptual ideas include: • CAD programmes • free-hand and instrumental drawing of 3D and 2D models • verbal explanations • video.	Focus on introducing to students new skills and/or modes for communicating design ideas.	

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 other practice to identify how materials have been justified as being suitable for use in the technological outcomes.		
	Develop an attribute profile for the materials used in an existing product that is familiar to students, eg, chairs around the school.	Match material specifications to the specifications needed for the product to be fit for purpose, in terms of, for example, rgonomics, material selection, aesthetics. 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 functional modelling to determine their advantages and limitations.	Functional modelling tools explored could include: CAD programs – Autodesk, Pro/DESTOP, Pro/ ENGINEER, SketchUp 2D, 3D modeling in hard and soft materialsvideo Photoshop, InDesign, Illustrator – this could support showing the conceptual design virtually in its intended social and physical environment.	
	Analyse other practice to determine the nature of the overall practice they applied, and the functional modelling tools and techniques used to test the developing technological outcome.	Use exemplars of student work and/or case studies off the Techlink website.	
	Supporting students with specialist knowledge and experience in construction/manufacturing processes.		
	Trialing and demonstrating prototype performance using criteria with which to gather data to evaluate the technological outcomes fitness for purpose.		
Evaluate the fitness for purpose of the final outcome against the specifications.	Analyse case studies of other practice to identify the tools and strategies they used to justify their technological outcome as being fit for purpose.	Peer Evaluation: students present a prototype to an audience for evaluative feedback, using written evaluations, PowerPoint and/or a video presentation.	

OUTCOME DEVELOPMENT AND EVALUATION: SUPPORTING LEARNING ENVIRONMENT LEVEL 6

To support students to undertake outcome development and evaluation at level six teachers could:

- ensure that there is a brief with clear specifications against which a developed outcome can be evaluated.
- 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 modeling.
- provide a range of materials/components and the opportunity to develop the necessary knowledge and skills to test and use them.
- support students to undertake prototyping to evaluate the outcome's fitness for purpose and identify any further development requirements.
- ensure students gain targeted stakeholder feedback.

Focused Learning	Teaching Strategy	Explanation	Modification/ 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 another's practice to identify features that completely address the attributes (specifications it was designed to perform/ meet) and those that only partly address them. Suggest refinements where necessary to enable the outcome to completely address all of its intended attributes.	Students identify the types of knowledge and understandings required by the technologist (person who made the outcome) in order to produce their technological outcome. Have students focus on: • materials that were usedthe tests undertaken to justify the outcomes addressing of the need or opportunity • component parts included in the outcome, and the role that they played in the overall function/aesthetic qualities of the outcomethe knowledge from other domains that the technologist drew on to develop their outcome.	
	Analyse existing products that have similar functional properties to those required in the outcome students are developing.	Use a PMI chart to identify the functional properties that may be useful to consider when students are developing their own outcome. Identify 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 have identified their key stakeholder/s.	
Undertake functional modelling to refine design ideas and enhance their ability to address the specifications.	Develop students modelling techniques to: • test conceptual ideas • communicate conceptual ideas.	Look at models, mockups, testing and trialing software that enables the communication and testing of conceptual ideas: • Pro/ENGINEER (3D modelling software) • Blender (shareware) Explore ways/techniques to test conceptual ideas including: • CAD software • physical drawing • 3D and 2D models • verbal – Audacity (audio editing software) • VoiceThread (group sharing editing software) • video. Analyse the advantages and disadvantages of each communication technique.	
	Explore techniques for gaining wider community feedback.	Explore techniques for effectively communicate ideas to obtain feedback from key and wider community stakeholders, including: email; Skype; phone; fax; solid modelling. Analyse the 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.	Analyse case studies of other practice to identify how they have justified material suitability for their technological outcome(s).	Use resources to assist students to identify materials, such as:; Nuffield books; STAR profiling; Inspiration software; SKRBL software. Students to explore treasons why they may have been selected for the inclusion in the outcome.	
	Develop an attribute profile for the materials used in an existing product that is familiar to students. Repeat activity with products with which students are initially not familiar.	Do exercises such as SCUMPS – Size, Colour, Uses, Materials, Parts, Shape. Relate these prompts to 'What if…?' questions: • What if you change the colour of the outcome/ materials? • What if you change the use of the outcome? • 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?	
Evaluate the conceptual design against the specifications to determine the proposed outcomes potential fitness for purpose.	Demonstrate and have students explore a variety of tools that can support functional modelling.	Students investigate how to undertake functional modelling using tools such as: • CAD software– Autodesk, Pro/DESKTOP, Pro/ ENGINEER, Google SketchUp • 2D, 3D modeling using hard and soft materialsvideo Photoshop, In-Design Illustrator – this could support creating a virtual conceptual design in its intended social and physical environment.	
	Analyse the practice of others to determine the nature of the overall practice they applied and the functional modelling they used to test their developing technological outcome.	Use exemplars of student work or case studies from 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 case studies of technological practice to identify how the technological outcome has been justified as being fit for purpose. Have students present and justify their outcomes as being fit for purpose to an expert technologist and receive their feedback.	Students observe their own work through a fresh pair of eyes. This new perspective from an un-biased source can then inform their own practice.	
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 that can support functional modelling to determine their advantages and limitations.	Functional modelling tools explored could include: • CAD software– Autodesk, Pro/DESKTOP, Pro/ ENGINEER, Google SketchUp • 2D, 3D modeling using hard and soft materials • video • Photoshop, In-Design Illustrator – this could support creating a virtual conceptual design in its intended social and physical environment.	
	Supporting students with specialist knowledge and experience in construction/ manufacturing processes.		
	Trialing and demonstrating prototype performance using criteria with which to gather data in order to evaluate the technological outcomes fitness for purpose.		
	Analyse the practice of others to determine the nature of the overall practice applied, and the functional modelling tools and techniques used to test the developing technological outcome.	Use exemplars of student work and/or case studies from the Techlink website.	
Use stakeholder feedback to support and justify key design decisions and evaluations of fitness for purpose.	Analyse case studies of technological practice to identify the tools and strategies used to justify the technological outcome as being fit for purpose.	Peer Evaluation: Students present a prototype to an audience for evaluative feedback, including written personal evaluation and/or ideo presentation.	

OUTCOME DEVELOPMENT AND EVALUATION: SUPPORTING LEARNING ENVIRONMENT LEVEL 7

To support students to undertake outcome development and evaluation at level seven teachers could:

- ensure that there is a brief with clear specifications against which a developed outcome can be evaluated.
- 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 modeling.
- provide a range of materials/components and the opportunity to develop the necessary knowledge and skills to test and use them.
- support students to undertake prototyping to evaluate the outcome's fitness for purpose and identify any further development requirements.
- ensure students gain targeted stakeholder feedback.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Generate design ideas that are informed by research and critical analysis of existing outcomes.	Analyse a case study or technological outcome 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. Questions that could be used to support this identification 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, and 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, and 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 modelling	
Develop design ideas for outcomes that are justified as feasible with evidence gained through functional modelling.	Trial ways of modelling to test and communicate conceptual ideas. Identify advantages and disadvantages of each model and determine situations when each would be best to use.	Explore modelling, mockups, testing and trialing software that enables functional modelling to be undertaken. Examples of software include: • Autodesk (good software) • Blender (free software)	
	Explore strategies to gain wider community feedback.	Explore means of capturing evidence of testing and communicating conceptual ideas using: • CAD software • physical drawing • 3D and2D physical models and mockups • verbal – Audacity, VoiceThread • 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 technological practice to identify how the materials used in the technological outcome have been justified as being fit for its intended purpose.	Examples of tools to support functional modelling of component parts of a conceptual idea or the overall concept itself to test fitness for purpose include: CAD software– Autodesk, Pro/DESKTOP, Pro/ENGINEER, Google SketchUp 2D, 3D modeling using hard and soft materialsvideoPhotoshop, In-Design Illustrator – this could support creating a virtual conceptual design 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 applied and the functional modelling used to test the developing technological outcome.	Use exemplars of student work, case studies from the Techlink website or a visit to a practicing technologist to observe and discuss their practice when developing a technological outcome. Focus on functional modelling techniques that are used to test and form the development of the outcome and ensure its overall fitness for purpose.	
	Using functional model to test design ideas and gain feedback which can be evaluated.	Use PMI charts to order and sort results from testing and feedback. Evaluate to determine a design idea's potential as a conceptual design that could be used to develop a technological outcome	
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 technological practice to identify how the technological outcome has been justified as being fit for purpose.	Have students present their findings to justify the outcome as being fit for purpose.	
	Have students present their technological outcome as being fit for purpose.	Students present to peers and/or a practicing technologist.	
	Explore product testing techniques to test the fitness for purpose of a developed product with wider community stakeholders such as: using randomly selected, representative sampling or control group testing panels monadic testing paired-comparison testing.	Trial different strategies with wider community stakeholders using an existing product to determine when best to use these strategies and the validity and reliability of the feedback received.	
Undertake prototyping to gain specific evidence of an outcomes fitness for purpose and use this to justify any decisions to refine, modify or accept the outcome as final.	Expose students to a range of prototyping techniques (use the internet, eg, YouTube).	Students must produce a prototype that can be evaluated against the specifications.	
	Identify the key element/s to be tested in a prototype and how the test is to be conducted.	Students explore how others conduct tests to determine the fitness for purpose of their prototypes. Students analyse these to determine tests that 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 the outcomes as fit for purpose.	The criteria developed will need to allow 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 placed in order to evaluate all the environmental factors both known and unknown (physical and social).	

OUTCOME DEVELOPMENT AND EVALUATION: SUPPORTING LEARNING ENVIRONMENT LEVEL 8

To support students to undertake outcome development and evaluation at level eight teachers could:

- ensure that there is a brief with clear specifications against which a developed outcome can be evaluated.
- 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.
- 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 modeling.
- provide a range of materials/components and the opportunity to develop the necessary knowledge and skills to test and use them, and support students to establish which 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.
- ensure students gain targeted stakeholder feedback and understand the implications of the physical and social environment in which the outcome is to be located.

Focused Learning	Teaching Strategy	Explanation	Modification/ 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 were the types of knowledge the technologists needed to know in order to ensure the outcome was 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.	
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 conceptual ideas. Identify advantages and disadvantages of each model and determine situations when each would be best to use.	Students explore modelling, mockups, testing, trialling software that enables them to model: • Autodesk (good software) • Blender (free software) Identify the advantages and limitations of this software. Capture evidence for testing and communicating conceptual ideas using: • CAD software • physical drawing • 3D and2D physical models and mockups • verbal – Audacity, VoiceThread • video.	
	Students explore strategies to gain 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 fitness purpose	Explore thinking tools such as: • CAMPER (consequences, actions, minimisations …) • SWOT/SWOB analysis • Waterfall questions • 'What if…?' questions.	

An evaluation of design ideas is informed by critical analysis of others' evaluative practices. Undertake the development of a conceptual design for an outcome that optimises resources. Take into account maintenance and disposal implications.	Break down complex ideas into smaller, more understandable parts.	An example could be the Inspiration software template The Right Tree www.ted.com/talks/pattie_maes_demos_the_sixth_sense.html	
	Analyse the relationship between the materials and the use within a technological outcome.	A possible topic is material (eg, the use of silver within an item of jewellery). 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 The student is asked to discuss the material in relation to topics ABC. 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.	
	Using tools to support functional modelling	Functional modelling tools could include: • CAD software– Autodesk, Pro/DESKTOP, Pro/ENGINEER, Google SketchU, Vectorworks – this could support showing an outcome in its intended social and physical environment. • 2D, 3D modeling in soft and hard materials • video • Photoshop, In Design, Illustrator	
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 technological outcome.	Use exemplars of previous student work, case studies from the Techlink website or a visit to a practicing technologist to observe and discuss their practice when developing a technological outcome. Focus on functional modelling techniques that are 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 implications.	Analyse case studies of others' practice to identify how they have justified their technological outcome as being fit for purpose.		
	Have students present and justify their outcomes as being fit for purpose to an expert technologist (Dragons Den format) and receive their feedback.		
	Identify advantages and disadvantages of product testing techniques to test the fitness for purpose of the developed product with wider community stakeholders	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, eg, YouTube).	Students must produce a prototype that can be evaluated against the specifications.	
	Identify key element/s to be tested. Construct a prototype that is able to be justified as fit for purpose	Evaluation strategies: • Criteria to evaluate against • Informed experts/focus group	
	Stakeholder feedback considered when deciding 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 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 to justify the outcomes as fit for purpose.	The criteria developed will need to allow informed experts/ focus group to judge the success or otherwise of the outcome. Students must have access to 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).	
		Students to demonstrate that the evaluation was robust enough to determine that all functional properties in the product were covered (triangulation).	

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: SUPPORTING LEARNING ENVIRONMENT LEVEL 1

To support students to undertake planning for practice at level one 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 from.

Focused Learning	Teaching Strategy	Explanation	Modification/ Reflection
Describe what they have done already.	Brainstorming an intended process (practice) in relation to a process students have previously been through.		
	Take photos of key stages of a familiar process – students organise them so they illustrate process.	Have students order the photos so in the sequence in which they undertook their process/ practice.	
	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 to do this.	
Identify what they will do next.	Create a Flow chart template with broad categories of the steps to go through to produce the outcome.	Students to complete the template describing and drawing each step of the practice they intend to undertake, and identifying the key resources they could use. Possibly have some steps missing for students to identify.	
	Deconstruct the activities of a process that students are familiar with, such as putting shoes on, making toast.	Using a flow chart template get students to draw and explain the steps required to complete the process.	
	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 part of the process they might go through to develop a technological outcome.		
Identify the resources they might use.	Photos of the resources and/or samples of the resources students could possibly use to develop a technological outcome.	Students to: • select the resources in the order they would use them to develop their technological outcome • explain why they have selected them in this order.	
	Brainstorm the likely practice required to develop a technological outcome to an identified issue. Teacher to record what students already know and, where necessary, fill in the gaps.		
	Identify the resources that are the Odd One Out.	Have tangible resources and get students to describe which ones are the odd one out – ie, one that might not be appropriate for developing a technological outcome to an identified (and fully explored) issue.	
	Resource Grouping	Images of, or tangible, resources that students are asked to group according to the stages they would follow to undertake their practice of developing a technological outcome, for example: research resources, concept generation resources, making resources, testing resources etc.	

PLANNING FOR PRACTICE: SUPPORTING LEARNING ENVIRONMENT LEVEL 2

To support students to undertake planning for practice at level two 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 of these they wish to use in their outcome.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Identify and record the key stages and resources required to produce their outcome.	Game play: "What comes next?"	Give students a set of photographs of a sequence of steps undertaken to develop a technological outcome, with a missing bits at the end. Students to contribute either next possible step or what the finished outcome would/could be. Repeat activity but with a step(s) missing within the middle of the sequence and have student determine the missing step(s).	
	Students in pairs use the dice with questions to identify what they need to consider.	Use a teacher-created dice with questions that are specific to your 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? • etc	
	Record on 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 the products through 'predicting' what the products are used for and where, who uses them, how they were made, etc. Use a template with stems for students to complete. For example: Outcomes will: • be used to … This will … • be used by … to … • will enable/allow … by … • was made by … using … (resources/equipment).	
Describe what they have done already and what resources have been used.	Buddy chat – in pairs describe what they have done already and what resources have been used.	Encourage the student listening to ask questions such as: Why did you do this? How did it help you? What will you do next? What resources will you need?	
Explain what they are going to do next.	Students complete a template to record from a bank of resources (pictures and/or tangible). Resources that they think they will need to produce their technological outcome to meet agreed attributes.	Provide a range of pictures of and/or tangible resources for students to see and interact with to determine the resources they will use and the order in which they will use them.	

PLANNING FOR PRACTICE: SUPPORTING LEARNING ENVIRONMENT LEVEL 3

To support students to undertake planning for practice at level three 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 develop their own design process
- provide a range of resources for students to select from and guide students to select those that will be appropriate for their outcome
- guide students to review their plans at key points and reflect on progress to make informed decisions regarding earlier plans and resources

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Develop a plan that identifies key stages, and resources required to produce their outcome.	Identify key stages in someone else's technological practice.	Provide students with a description (video, photos and/or flow chart) of the key stages used within technological practice to develop a technological outcome. Students to identify what would happen if (in relation to a process(es) and/or use of resources – tools, materials). Students explain the consequences if a particular key stage was not undertaken within the practice to develop the technological outcome and/or if a resource was not used. Buddy chat – students discuss in pairs.	
	Students create a flowchart of the key stages and the resources required at each stage	The teacher could create the initial flowchart with some of the key stages, leaving space for students to add the more specific stages as they go.	
	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. Students to identify the key stages followed to develop the technological outcome and the resources that were used. Record these stages and resources used on a flow chart template.	
	Review photos of previous technological practice and identify the key stages followed within this.	Identify the resources that were used and record these on blank cards beside the appropriate photos. Use this sequence of photos and resources as a class planning tool on the wall to structure/ inform next practice.	
Review progress through the keys stages and resources used to date and use this to inform future planning decisions.	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 outcome.	
	Students in pairs use the dice with questions to identify what they need to consider.	Use a teacher created dice with questions that are specific to your 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 their previous practice used to develop a technological outcome with their current practice.	Students to focus on identifying similarities and differences (Venn diagram).	
	Students analyse the technological practices undertaken by another person (eg, senior student). From this they determine the key stages that could be used to develop their own technological outcome.	Students to focus on identifying practices that could be used and/ or refined into their own practice, and those that are additional which need to be included in order to allow the development of their outcome.	

Plan, explain and record ideas for future activities to support the completion of their outcome.	Class/group brainstorm (GANTT charts) to consider next key stage and the resources necessary to complete it in terms of time, tools, materials, people etc.	Teacher provides a GANTT chart template and guides students through the process of completing it.	
	Using a class developed GANTT chart, students record the changes (and explain reasons for these changes) for the technological practice they undertook to develop their technological outcome.		
	Group discussion/decision-making session(s) to consider and agree on way forward 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 practice they should undertake to develop their outcome.	
Identify key resources suitable to complete their outcome.	Students are provided with a total list of the resources that could be used to develop a technological outcome to address a need or opportunity. Students are invited to remove those resources not crucial to the development of their outcome.	From the available resources (groups of) students choose the resources they will use (eg, ingredients, utensils etc) and produce an outcome that addresses the directed brief. Once the outcome is 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, the order of which are then randomly mixed. Student B then predicts the needs for Student A by finding and giving them back the pieces of paper that are their resources.	

PLANNING FOR PRACTICE: SUPPORTING LEARNING ENVIRONMENT LEVEL 4

To support students to undertake planning for practice at level four teachers could:

- ensure that there is a brief against which planning to develop an outcome can occur.
- provide planning tools and support students to record key stages and resources needed, including when they will need to access. stakeholder feedback. (Please note; records only need to capture what students plan to do and what they need to do it to guide their practice and allow them to review this periodically).
- support students to review their plans at key points and reflect on progress to make informed decisions regarding earlier plans and resources.
- support students in organising their resources (including time, money, materials, equipment and access to stakeholders etc).

Focused Learning	Teaching Strategy	Explanation	Modification/ Reflection
Establish a plan to manage resources and stakeholder interactions, setting out key stages, actions to be undertaken and progress review points.	In groups, students revisit a planning tool they have used and discuss the usefulness of this tool as a means of recording and informing the practice 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: similarities and differences between the planning tools that were usedwhere within the practice they were used how the tool(s) were used to inform the practice undertaken.	
Review progress according to the current plan, and revise planning as appropriate to ensure completion of outcome	Use planning tool(s) to plan overall practice and structure key stages, base this planning on knowledge gained from undertaking previous planning actions.	Encourage students to reflect on tools that worked well and those that didn't from aspects of their previous planning practice. Ensure students use understandings developed to inform selection of planning tools for their next practice.	
	Class discussion on the most appropriate planning tool 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.	Students review the practice of others (senior students and/or practicing technologists) to identify the planning strategies/tools that were used to obtain stakeholder feedback. They analyse these to identify if they enabled 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 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 other practice to identify how they planned ahead and documented their practice.	Use case studies from the Techlink website of student practice and/or the practices of practicing technologists.	
	Teacher questions students/groups about the list of resources they have identified as needing in order to undertake technological practice to develop a technological outcome.	Question students/groups about how 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.	
	Ask students to put into sequence a set of photos of the technological practice of someone else (senior students and/or a practicing technologists).	For each photo, ask students to identify the: • resources that where necessary to enable them to carry out their practice • aspects that needed management; for example, safety, storage, resources requiring handling in a specific way, disposal of waste etc.	

PLANNING FOR PRACTICE: SUPPORTING LEARNING ENVIRONMENT LEVEL 5

To support students to undertake planning for practice at level five 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 record1 their planning (Please note: records only need to capture what students plan to do and what they need to do it to guide their practice and allow them to review this periodically).
- support students to review past planning decisions in an ongoing manner and evaluate progress to inform their ongoing planning.
- support students to manage their resources (including time, materials, money, equipment and access to stakeholders etc.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Select and use planning tools to identify and record key stages, actions to be undertaken, determine progress review points, and manage resources.	Revisit a 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 possible planning tools they used.	Select a product/collection and, using information provided, predict their ideas about: • What planning tools might have been used? • What might have been their key stages? • What might have been the actions they needed to undertake? • When might they have reviewed their progress? • What would have 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.	Critique the planning tools in the context of the specific brief. Discuss and justify: • Does the planning tool suit the brief? • Why/why not? • Modifications that could be made to the planning tool Rest of class to critique their justifications.	
	Progress review points/Managing resources trials.	Class is split into groups, all creating an outcome (eg, origami) within one lesson. Some groups are deliberately given insufficient resources/time/ people. Group A has only one final review point. Group B has maybe two. Group C have several progress review points. Some progress review points are purposefully placed in the wrong places. Discuss and reflect on the outcomes achieved and what assisted/hindered the attaining a quality outcome.	

Use planning tools to record initial plans and ongoing revisions in ways which provide justification for planning decisions made.	Discussion on the most appropriate planning tool for different aspects of practice.	Class discusses the most appropriate planning tool for different aspects of practice in, for example: initial planning of intended key stages planning for resource management and activities within an identified key stage etc. planning materials flows	
	Teacher-led example of how to use planning tools.	Teacher shows how to plan overall practice and structure key stages. Base this planning on knowledge gained from undertaking previous planning actions. Encourage students to reflect on and discuss what worked well and what didn't in aspects of their previous planning practice. Encourage students to use 'linking' words in their discussions such as: • … because … • … and therefore … Use understandings developed to inform next planning.	
	Oral justification	Student(s) talk to rest of the class about the planning tools they are using, justifying their decisions by explaning why they chose these tools, including the advantages and disadvantages of tools consdered. Their peers can question them and find out more about different tools.	Suggest this is done in-depth, one student per session.
	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. Stages could be, for example, the mixing and blending of ingredients for a muffin, the identifying of a type/style of garment suitable to be worn at an identified special event. Students are also supplied with a range of planning tools. The students are asked to match the outcome/ stage to an appropriate planning tool and justify their choice. Teacher questioning will ensure deeper thinking through using three storey intellect or Bloom's Taxonomies.	
	Create a dice with focus questions.	Students create questions that will focus them and others to ensure their justifications are appropriate, by referring to: • planning decisions made • planning tools selected • planning tools dismissed • altered paths chosen • modifications to outcome. The dice can then be used as a planning tool for them and other classmates	
	Teacher questioning students about the list of resources they will need to organise in order to undertake technological practice to develop a technological outcome.	Question students about such things as: • the appropriateness of the identified resources • how they will manage the resources during their practice to maximise efficiency of their practice and achieve the desired outcome • when they will need to access the resource(s) for each stage • what will happen to the resource(s) once the key stage is finished, etc.	

PLANNING FOR PRACTICE: SUPPORTING LEARNING ENVIRONMENT LEVEL 6

To support students to undertake planning for practice at level six 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.
- ensure tools selected by students will provide appropriate support for their practice.
- support students to use selected tools to effectively manage resources (including time, materials, money, equipment and access to stakeholders etc) to enable the outcome produced.

Focused Learning	Teaching Strategy	Explanation	Modification/ Reflection
Select appropriate planning tools informed by the critical analysis of own and other planning practices.	What does critical analysis mean?	Critically analyse a technological outcome (or a photo of the outcome) in regard to a specific functions/attributes (such as ergonomics, fitness for purpose etc). Focus on creating 'fertile' questions that allow for 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 used? Then move on to Techlink classroom practice case studies (www.Techlink.org.nz/Case-studies/Classroom-practice/index.htm), and use a real world technological practice case study. Use these points as a class to create focussed questions with which to approach the case study: • What overall planning and project management tools were use? • How did they 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 to add to this list.	
	Students critically analyse own past planning and organisational practice.	(The above modelling and activity needs to be done first.) Students critically evaluate their own practice, focusing on such things as: • their(own) overall planning and project management • ways of ensuring the fitness for purpose of their(own) past outcome • strategies for gaining access to stakeholder feedback • resource management and how this was planned for.	
Use planning tools to plan for the effective management of resources to ensure completion of an outcome	Use of physical and virtual, planning and modelling techniques.	Students are provided with the opportunity to place/imagine their outcome in its intended physical and social environment, by using physical and/or virtual modelling techniques (eg, testing of materials, trials with mock-ups, CAD trials, crocodile-clips). Students then discuss and substantiate their judgments about the success or otherwise modelling their outcome in its intended physical and social environment: • What were the risks/issues identified? • How can these be minimised/eliminated to ensure the successful completion of the outcome.	
	Identify the strengths and weaknesses of different planning tools.	Students focus on answering questions such as: • What is the 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 an outcome(s) is fit for purpose?	

Use planning tools to record initial plans and ongoing revisions in ways which provide justification for planning decisions made.	Explore contexts and issues.	Provide students with a variety of scenarios (contexts) that they can critically evaluate to identify issues that provide opportunity for the undertaking of technological practice to derive a feasible solution. Students undertake feasibility studies on these issues and determine the likely technological practice 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, such as: • as a result of … • because … • therefore … Refer to Effective Literacy strategies book for Secondary Schools.	
	Model justifications.	The class formulates model justifications based on classmates projects or hypothetical scenarios/issues	
	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 Bloom's Taxonomy. Students to identify: • the advantages/disadvantages of each of these toolswhen to use what toolthe levels of appropriateness of the tools for a particular project.	
	Justifying the management of resources in terms of the physical and social environment in which they are used.	Students to critically evaluate: • another's practice (case study and/or observation of a practicing technologist's 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 the resources were managed within the physical and environmental location in which they were used.	

PLANNING FOR PRACTICE: SUPPORTING LEARNING ENVIRONMENT LEVEL 7

To support students to undertake planning for practice at level seven 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 use selected tools to effectively manage resources (including time, materials, money, equipment and access to stakeholders etc) to enable the outcome produced to successfully meet the brief.

Focused Learning	Teaching Strategy	Explanation	Modification/ Reflection
Select appropriate planning tools and develops project management practices informed by the critical analysis of own and others' planning practices	Critically analyse another's (practicing technologist) project management practices through evaluation of case studies and/or their actual practice as observed/ presented.	Students critically evaluate the practice of others, focusing on such things as: • the planning and project management tools used • planning to enable verification of the fitness for purpose of outcome • management practices to ensure valid stakeholder feedback was accessed • planning used to manage the efficient use of resources • a comparison with the student's own practice.	
	Flowchart a practicing technologists practice and critically analyse it to inform own practice.	Flow chart showing … • What the analysis of a technologists practice told them • Implications/findings/what I learnt • How I will/did use that learning	
	Develop project management practices of either a real project or a simulated one off, using roles in group situations.	Each student takes a different role, for example:; project manager; resource manager; time-keeper; construction manager. Answer questions such as: • What qualities does each role need? • Evaluate success against the roles? • What part does each role play to the overall success of the practice? • How are these roles reflected in my own practice, when I am required to undertake all of these roles myself?	
Use planning tools and project management practices to plan for the effective management of resources to ensure completion of an outcome.	Look at your use of planning/ modelling tools and determine the likely accuracy/validity of projections based on findings obtained from them.	Focus on identifying the strengths and weaknesses of each planning/modelling tool in terms of allowing accurate and valid projections to be made.	
	Use of physical and virtual, planning tools and project management practices and modelling techniques.	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 the physical and/or virtual planning and modelling techniques.	
Use planning tools to record initial plans and ongoing revisions in ways which provide justification for project management practices.	Exploring contexts and issues.	Provide students with a variety of scenarios (contexts) which they can critically evaluate to identify the issues that provide opportunity for the undertaking of technological practice to derive a feasible solution. Students undertake feasibility studies on these issues and determine the likely technological practice required to develop an outcome that addresses the issue.	
	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 Bloom's 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.	
	Justifying the management of resources in terms of the physical and social environment in which they are used.	Students critically evaluate: • another's practice (case study and/or observation of a practicing technologist's practice) to determine how well they managed resources within the physical and environmental location in which they used, and if the 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: SUPPORTING LEARNING ENVIRONMENT LEVEL 8

To support students to undertake planning for practice at level eight teachers could:

- ensure that there is a brief against which planning to develop an outcome can occur.
- ensure students critically analyse a range of planning tools and project management practices that have been used in past technological practice.
- support students to select planning tools and project management practices that will ensure the efficient development of an outcome to completion. Efficient management of resources ensures that the use of time, material and people is optimised during the development and production of an outcome that successfully meets the brief.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Select appropriate planning tools and develops project management practices informed by the critical analysis of own and others' planning practices. NOTE only difference from Level 7 to Level 8 is the word 'ensure' in the guidance section. Focus is therefore placed on providing strategies to help students self direct their own practice in order to allow the teacher's to adopt an 'ensure' role.	Strategies/techniques for undertaking feasibility studies to determine a suitable context and issue, and subsequently identify a need or opportunity.	Explore the use of strategies/techniques such as:; mind mapping tools; graphic organisers; compare and contrast. Students focus on answering questions such as: • Is the issue likely to provide an opportunity to develop a technological outcome that has the potential to be fit for purpose for the physical and social environment in which it will be placed? • What constraints (eg, political, social, moral, ethics, economic) will likely impact on the technological practice undertaken to develop a technological outcome, and the outcomes themselves? • Is the context providing opportunities for the student to engage in appropriate learning activities that increase their breadth, and depth of knowledge and skills?	
	Explore unsuccessful products and their project management practices (or lack of!).	Students focus on identifying the planning practice(s) that were missing in a project from www.baddesigns.com or www.YouTube.com/watch?v=3rOtS7wsZCo&feature=related: • What project management practices were incomplete in: • risk management; planning tools chosen • When could they have identified that it was becoming unfit for purpose? • What are constraints identified/not identified? • How could constraints have been considered?	
Use planning tools and project management practices to plan for the efficient management of resources to ensure completion of an outcome	What is efficiency?	Students define efficiency. • What does efficiency look like in technology? • How does it affect project management? Students evaluate efficiency in a technologist's practice, comparing and contrasting the fitness for purpose of their technological outcome(s).	
	Use an Efficiency Competition to model what efficiency is.	Students are divided into in groups. Each group has same resources, time and instructions etc, to create the one-off product. Students plan before the task what they could do to ensure efficiency (eg, use minimum resources/use mock-ups and patterns to ensure efficient use of materials). Students evaluate the success of planning practice against the success of the one-off product they create (its fitness for purpose).	
	Students should be aware of the integrative nature of these indicators.	Students are encouraged to critically evaluate their planning practice to determine its 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?	
Use planning tools to record initial plans and ongoing revisions in ways which provide justification for project management practices employed.	Strategies for future projection – use of creative thinking.	Examples include:; 'What if…?' questions; De Bono; Inquiry learning strategies; organisations of think tanks; Secondary Futures resource.	
	Critically evaluate another's (practicing technologist) project management practices through analysis of case studies and/or their actual practice as observed/presented.	Students critically evaluate the practice of others, focusing on such things as: • the management tools used • the opportunities created and/or constraints resulting from specific practices undertaken the management of resources and how/if this was undertaken in an ongoing manner through-out technological practice • justifications for the planning and management practices adopted in terms of the physical and social environment in which the practice took place • how they ensured practice always focused on the context and issue.	

BRIEF DEVELOPMENT

The examples of teaching strategies listed below are shown against specific curriculum levels , although many are appropriate at multiple 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 ensure that the teaching strategy adopted enables a focus on improving student abilities to 'justify'.

BRIEF DEVELOPMENT: SUPPORTING LEARNING ENVIRONMENT LEVEL 1

To support students to undertake brief development at level one teachers could:

- provide the need or opportunity and develop the conceptual statement in negotiation with the students.
- provide a range of attributes for discussion and guide students to identify the attributes an appropriate outcome should have.

Focused Learning	Teaching Strategy	Explanation	Modifications/Reflections
Communicate the outcome to be produced.	Talk about technological products.	Have students explain the attributes and uses for a range of known technological products. For example, a pencil is made from wood, used to write and draw.	
	Literacy development – use of describing words.	Get students to describe products using terminology such as: light, heavy, shiny, red, plastic, paper etc.	
	Describing products from drawings.	Students are asked to describe from a picture of a known product such things as: • What it is made from?What is its colour, shape?What it is used for?	
	Using 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. This can be in a written format (by teacher) or visual format (by students). Have a range of products prepared for student engagement.	
Identify attributes for an outcome.	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/are used for, what they are made from, where they are used etc.	
	Describing who will use an 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 …	

BRIEF DEVELOPMENT: SUPPORTING LEARNING ENVIRONMENT LEVEL 2

To support students to undertake brief development at level two 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.

Focused Learning	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.	Use a range of known and unknown technological products so that students explain them: • from their experience of interacting with them • through 'predicting' where they are used, who uses them etc.	
	Explaining 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 to … This will … • be used by … to … • 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 of technical words.	Getting students to describe products using terminology such as: plastic, attributes, wood, copper, stakeholders, gears, lever, screw 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 outcome. For example: Outcomes will: be used by stakeholders who will … be made from 3mm diameter wire … be shiny to reflect … oval in shape to …	
	What are resources?	Teacher prepares a collection of physical resources or photographs. Discuss: • What are resources? • What resources will be used for this outcome?	

BRIEF DEVELOPMENT: SUPPORTING LEARNING ENVIRONMENT LEVEL 3

To support students to undertake brief development at level three 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 (eg, 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.

Focused Learning	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	Describe their outcome using key questions	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?	
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.	Matching a list of described 'key' attributes (eg, made from soft spongy material that is light weight) to a range of products that students are both familiar and unfamiliar with.	
	Describing 'key attributes', for their outcome.	Use a template with stems for students to complete. For example: This outcome: • will be used to … • look like … • feel like …	
	Matching key attributes to technological products	Matching phrases that describe attributes of technological products to pictures of products, eg, 'able to cut paper' matched to 'scissors'.	
	Using the 'key' attributes of given products, students identify what the product is/does.	This will be used by … to … This will be 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 developed 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 evaluating their peers developed products against their brief, making suggestions for changes to 'key' attributes to allow an evaluation to occur where necessary.	
	Using a 'touchy/feely bag'	Getting students to describe attributes of products using terminology that enables others to know what the product is: • made from • shaped like • used for. Students asked to describe a range of products concealed within a bag that they can physically touch but not see 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. Students asked to identify what the product is.	
	Students evaluating the 'fitness for purpose' of products against given attributes.	Evaluate a range of products against a set of given attributes to determine their 'fitness for purpose'.	

BRIEF DEVELOPMENT: SUPPORTING LEARNING ENVIRONMENT LEVEL 4

To support students to undertake brief development at level four 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
- guide students to understand the physical and functional nature required of an 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.

Focused Learning	Teaching Strategy	Explanation	Modifications/Reflections
Identify a need or opportunity from the given context and issue.	Brainstorming needs or opportunities from a given context.	Class brainstorms on board, datashow or 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 disaster.	Students to identify needs and/or opportunities for technological advancements/solutions that would have alleviated a disaster occurring (eg, building failures).	
	Personal contexts/issues.	Use personal contexts/issues to generate needs or opportunities. For example: What needs/opportunities exist in: • a messy bed*room?* • *tramping?*	
Establish a conceptual statement that communicates the nature of the outcome and why such an outcome should be developed.	Analysing conceptual statements.	Providing students with a range of conceptual statements that have been used to develop technological outcomes. Encourage students to identify the 'key' information presented in the conceptual statements. For example: A need or opportunity will be resolved by the technological outcome: • Why it is needed? • Where will the outcome be used? • Who will use it?	
	Writing conceptual statements that describe a technological opportunity.	Presenting students with a range of needs/ opportunities and asking 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 practice writing 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).	
Establishing 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 that led to those attributes?	
	Stakeholder questions.	Developing a series of questions that can be used to interview a person that will identify their need or opportunity. See: • 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: Scissors: hair-cutting scissors – must be sharp, needle pointed end, comfortable to use. craft scissors – must be able to cut cardboard, blunt ended, plastic handle.	

BRIEF DEVELOPMENT: SUPPORTING LEARNING ENVIRONMENT LEVEL 5

To support students to undertake brief development at level five 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 an outcome.
- guide students to develop key attributes into specifications.

Focused Learning	Teaching Strategy	Explanation	Modifications/ Reflections
Identify a need or opportunity from the given context and issue.	Brain storming off a given context.	Class brainstorms on board, datashow or smartboard to identify potential needs or opportunities, including identification of who their stakeholders could be. Develop a series of questions that can be used to interview a person that will identify their need or opportunity.	
	Using a video of a natural or man-made disaster.	Students identify needs and/or opportunities for technological advancements/ solutions that would have prevented the disaster from occurring.	
	Personal contexts/issues.	Use personal contexts/issues to generate needs or opportunities. For example: What needs/opportunities exist in: • a messy bedroom? • tramping?	
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. (Use Techlink case studies, especially the student workbooks.)	
	Bulls-eye chart.	Draw three concentric circles – label the outside circle attributes, the middle circle 'key' attributes, and the inner circle specifications. Students to refine identified attributes into specifications (measurable/observerable performance expectations).	
	What? How? Why?	Students move from writing attributes to specifications, and then consider stakeholders. • The What = Attributes • The How = Specifications • The Why = Stakeholder considerations	
	Identify stakeholder considerations.	Create a client profile, to identify specifications that can meet their needs. See: Technology student website – client profile	
	Visiting technologists explain the practice they undertake to develop their brief (conceptual statements and specifications).	Students to seek justifications for the specifications written in the technologists brief (ie, why were they selected?).	
	Deconstructing an existing product to identify specifications.	Students write brief specifications for an existing product through deconstructing it to identify such things as materials made from, cost, size of components, relationships between components, safety considerations etc.	
	Students presenting their developed brief to the class.	Students focus on justifying why their selected specifications are important to the need/opportunity being addressed.	
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 issues/opportunities provided by teacher/identified from above activities.	
	Students present their conceptual statement to their class.	Students focus on justifying the nature of their outcome and why such an outcome should be developed.	
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 have been prioritised because of their intended use/ stakeholder needs. For example: Scissors: • hair-cutting scissors are made from surgical quality stainless steel, because … • craft scissors are made from carbon steel, because ….	
	Critiquing specifications to test their measurability or if they are observerable.	Sort a range of statements into those that are specifications and those that are not measurable/observerable. • What it is that makes a specification measurable? • What it is that makes a specification observerable?	

BRIEF DEVELOPMENT: SUPPORTING LEARNING ENVIRONMENT LEVEL 6

To support students to undertake brief development at level six 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

ensure students identify a need or opportunity relevant to the given issue and context

ensure students understand the physical and functional nature required of an outcome

support students to develop specifications and justify them based on key and wider community stakeholder considerations.

Focused Learning	Teaching Strategy	Explanation	Modifications/ Reflections
Identify a need or opportunity from the given context and issue.	Understand differences between a context, issue, needs and opportunity.	Scaffold students' understanding through activities such as: • First definition /second definition • Place mat • Use teacher-provided examples and Connected series to look at example (page 11, Support Material).	
	Identify issues, needs and/or opportunities from video/case studies that describe a context.	Do the same for issue and needs and opportunity. For examples of activities refer to the book Top Tools for Social Sciences Teachers.	
	Reviewing the technological practice undertaken by a technologist.	Students to identify potential issues, needs and/or opportunities and justifiy why they believe these are relevant to the context. Use Techlink Technological Practice case studies, video, 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 the issue, need or opportunity. This will also promote students skills in questioning techniques.Questions can go on to a dice template to be used by future students.	
	Potential client presenting their context.	Client (real or role-play) presents their context/issue. Students question client to gain more information. Based on this presentation/interview, the students identify the need or opportunity, and could also identify the 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		Expand on activities above	
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 evolve as the outcome progresses towards a technological outcome, for example: • client specifications to architect • architect specifications to builder. Students are asked to identify: • how specifications change according to their intended audience, and help clarify the justification for and needs of the outcome. • the constraints imposed by the brief on the outcome, and therefore on the practice to realise that outcome. Students determine 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.		Expand on activities above	
Justify the specifications in terms of key and wider community stakeholder considerations.	Analysis of the physical and social environment in which the technological outcome will be situated including feedback from stakeholders.	Use of evaluation tools such as : • CAMPER (consequences, actions, minimisations etc.) • SWOT/SWOB analysis	

BRIEF DEVELOPMENT: SUPPORTING LEARNING ENVIRONMENT LEVEL 7

To support students to undertake brief development at level seven teachers could:

- provide a context that offers a range of issues for students to explore.
- support 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.
- ensure students identify a need or opportunity relevant to the issue.
- ensure students understand the physical and functional nature required of an 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.

Focused Learning	Teaching Strategy	Explanation	Modifications/Reflections
Explore the context to select an issue.	Use of a range of evaluative tools to explore and evaluate a context.	Evaluation tools could include: • PMI • CAMPER (consequences, actions, minimisations, etc) • 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) to critically evaluate to identify issues that allow the undertaking of technological practice to derive a feasible solution. 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 above	
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 etc.	
	Student (and/or practicing technologist) critique of student developed conceptual statements.	Students (and/or practicing technologists) critically analyse other students' developed conceptual statements to ensure that they are robust and can be justified. How does the conceptual statement address the issue?	
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.	Discuss strategies for soliciting stakeholder feedback.	Students explore the advantages and limitations of the following kinds of strategies to obtain feedback from key and wider community stakeholders: • surveys • email, social networking sites • interview – face-to-face, phone, Skype	
	Teacher/students create a specifications checklist.	Do the specifications consider: • stakeholder feedback • the nature of the outcome • the need/opportunity • its environment • resources	

Communicate specifications that allow an outcome to be evaluated as fit for purpose.	Students work in pairs to clarify their specifications.	Students share their specifications with a partner. The key question each asks is: 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 – using linking words to provide justifications.	Encourage students to use linking language such as: • as a result of … • because … • therefore … • henceforth … • consequently …	
	Student (and/or practicing technologist) critique of student developed specifications.	Students (and/or practicing technologists) critically analyse each other's (student) specifications to ensure justifications presented are robust. Focus on answering questions such as: • How do the specifications address the need or opportunity? • How has stakeholder feedback been considered and incorporated? • How is the outcome's environment considered? • How do the specifications take into account the available resources?	

BRIEF DEVELOPMENT: SUPPORTING LEARNING ENVIRONMENT LEVEL 8

To support students to undertake brief development at level eight teachers could:

- support students to identify a context that offers a range of issues for them to explore.
- ensure students select an authentic issue within their selected context.
- ensure students identify a need or opportunity relevant to the issue and context.
- ensure students understand the physical and functional nature required of an 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 (eg, such things as the sustainability of resources used, ethical nature of testing practices, cultural appropriateness of trialing procedures, determination of lifecycle and ultimate disposal).

Focused Learning	Teaching Strategy	Explanation	Modifications/ Reflections
Identify and evaluate a range of contexts to select an authentic issue.	Use of student exemplars and case studies of technologists practice.	Analyse previous students' technological practice/case studies to identify the critical evaluation which occurred to determine a suitable context and issue to undertake technological practice. Questions that could be answered by students include: • What implications did the context impose on the technological practice undertaken to develop the technological outcome? • Who initiated these? • Who (stakeholders) were the beneficiaries and losers? • What were the consequences of implementing the technological outcome? • What was prioritised in developing and implementing the technological outcome?	
	Use of compare and contrast templates, such as a Venn diagram.	Students do exercises in comparing and contrasting such things as: • contexts • technological outcome • technological practices and their component parts – stakeholder interactions, technological modelling, planning techniques etc.	
	Identify suitable clients from possible issues.	Students to critically evaluate scenarios of potential client issues to determine their suitability as potential clients. Students to justify their choices.	
	Developing questions to determine client suitability.	Class brainstorms to identify questions that will solicit information that will determine a potential client's suitability, such as: • 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.	Student presents their need/opportunities to 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 example above	
	What is the wider context?	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 example above	
Communicate specifications that allow an outcome to be evaluated as fit for purpose in the broadest sense.	Student critique of a range of practicing technologist developed briefs.	Students critically analyse the practice of a range of technologists to develop a brief. Students to identify if the specifications are robust and will allow a developed technological outcome to be evaluated as being 'fit for purpose'. Vary the selection: architect, product designer, graphic designer, engineer, 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 example above	

CHARACTERISTICS OF TECHNOLOGY

The examples of teaching strategies listed below are shown against specific curriculum levels, although many are appropriate at multiple 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 ensure that the teaching strategy adopted enables a focus on improving student abilities to 'justify'.

CHARACTERISTICS OF TECHNOLOGY: SUPPORTING LEARNING ENVIRONMENT 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 world and the natural 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 purpose of technology is to design and create outcomes to carry out specific functions.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Identify that technology involves people designing and creating technological outcomes for an identified purpose.	Use pictures of products or actual objects and discuss what they do.	What is the product's/object's purpose?	
	Walking activity.	Go for a walk and identify objects that are a result of technology and those that are not. Identify the characteristics that make objects a technology.	
		Students bring in toys from home and discuss things such as: • Why was this toy made? • What may have the technologist been thinking in making the toy?	
	Visit to a practicing technologist to see the work he is involved in doing.	Discussions about what a technologist does.	
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.	Use a familiar object or picture. • Have a discussion to find out what students know and get them to draw some of these. • Provide ingredients and ask students to choose which ones they think would be appropriate – challenge with 'Why?'.	Objects from home, such as toys they play with – discuss what the technologist needed to do and know to make them. See scone-making activity, Level 3 below.	

CHARACTERISTICS OF TECHNOLOGY: SUPPORTING LEARNING ENVIRONMENT 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 world, the natural world and the social world and relationships between them.
- provide students with examples of technological outcomes and guide them to understand how they can increase people's capability to do things. Examples should allow students to recognise that increasing capability may result in both positive and negative impacts on society and/or the environment.
- provide students with examples of technological developments and guide them to identify how society and the environment influenced the decisions made.
- provide students with the opportunity to explore a range of technological developments and guide them to identify examples of positive and negative impacts on people and/or the environment.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Identify influences on particular technological developments.	Identify what influenced the attributes of familiar products.	Use a familiar products (eg,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 what influenced the incorporation of these attributes	
Identify how particular technological outcomes have changed how people do things.	Compare "old" and "new" versions of technological outcomes (products), such as domestic phone versus cell phone, games (board games versus electronic).	Pictures of older telephones (timeline of photos) to talk about 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	
	Watch Visa evolution advertisement , a short (1:03) video about the evolution of technology. Create a Venn diagram comparing the old with the new for example, a fax machine and texting. Choose one of the examples in the TV ad and list how it has changed how people do things (re-play video to focus on specific items).	What kind of technological outcomes are referred to in the advertisement? Are they old or new, eg, fax machines, texting, phones, record player/stereos, cell phones, iPods, TVs, laptops, typewriters.	
Describe examples to illustrate how a technological development has had a positive impact on society/environment.	De Bono's Thinking Hats = yellow hat	Choose a technological outcome (car, TV, soft drink) and discuss: how that technological outcome has helped people how that technological outcome has helped the environment.	
Describe examples to illustrate how a technological development has had a negative effect on society/environment.	De Bono's Thinking Hats = black hat.	As above but discuss how they have harmed people and the environment.	
	PMI (Positive, Minus, Interesting).	Chose developments that are obviously either positive or negative or ones that can be both – plastic drink bottles, for example, are positive for peoples' safety but negative for the environment.	

CHARACTERISTICS OF TECHNOLOGY: SUPPORTING LEARNING ENVIRONMENT LEVEL 3

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

- provide students with examples of technological practice and guide them to understand how social and/or environmental issues have influenced the development of the brief, planning decisions, and the development and evaluation of outcomes.
- provide students with the opportunity to explore a range of technological developments and support them to determine why changes in technological outcomes have occurred over time. Reasons for changes refer to such things as changing needs, fashions, attitudes and the development of new materials, skills and knowledge.
- support students to determine the impacts different technological developments have had on society and/or the environment over time.
- provide students opportunity to identify that knowledge is valued for what it can do and support students to identify that knowledge in technology is considered to be of value if it allows for a technological outcome to function successfully.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Describe examples to illustrate how social and/or environmental issues have influenced the technological practice undertaken.	Discussion starter cards. Engage in debate.	Use written descriptions and/or pictures of a social and/or an environmental issue (eg, recycling, obesity, security, reducing consumption) and descriptions and/or pictures of real technological practice. Use these as discussion starters: "How has XXX issue affected XXX practice/ outcome?"	
	Analyse contemporary and historical contexts where environmental and/or social issues have influenced the technological practice undertaken, for example, open cast mining, power generation turbines in Kaipara Harbor, wind farms, coal/gas generation, hydro generation, car airbags.	Develop a set of questions specific to the context being studied. Identify the social agencies (DoC, local iwi etc) that would have an impact on the decision today.	
	Use 'Train' PowerPoint that explains the gauge of train tracks.	This example identifies consequences and cause and effect.	
Explain why particular technological outcomes have changed over time.	Show a set of objects/pictures/words that have evolved over time eg, can openers, baby buggies, egg beaters.	Why have they changed? What caused this change? Was it, for example, ergonomics, planned obsolescence, development of new materials (plastics, synthetics, electronic components, etc)?	
	Create a timeline of a range of dissimilar technological outcomes.	See: Technology student website – timelines activity.	
	Students choose a technological outcome and investigate its development over history.	See: • Technology student website – bicycles • Technology student website – clocks	
Describe examples to illustrate how technological developments have changed society over time.	Take a product and talk about possible impact on a particular group.	Use the example to analyse what has happened to people as a result of a change. Produce a timeline with photographs of the product as it has evolved over time and a description of what has changed.	
	Use topical examples, such as milk powder, windmills, light bulbs etc.	What impacts have these products/ objects had on our lives? Use De Bono's thinking hats to get different perspectives.	

Describe examples to illustrate how technological developments have changed physical environments over time.	Discuss changes in physical environments. Compare photographs from current and historic periods.	Use a set of historic and contemporary photographs of the same area. Ask students to identify the changes and ask what may have caused these.	*Use Te Ara to provide images, audio and other information (this link is about gold mining).* *Use Digistore in the same way to provide a selection of photographs or audio or visuals for discussion.*
	Interview an older person.	Interview an older person about their life in earlier times. Have students listen and then identify the things that are not present today.	
Explain that technological knowledge is evaluated in terms of how effective it is in supporting an outcome to function successfully.	Create a bubble chart of possible knowledge required by students to develop a technological outcome that addresses an issue.	Students to identify: • knowledge they consider will be relevant to addressing the issue • knowledge that is missing in the bubble chart.	
	Create a 'Need to know' chart.	Student answer the following: • What do we know? • What do we need to know? • How do we find out?	
	Use Bro Town and/or 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 get them to ask themselves: 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 after-school snack).	Using this example, the specific knowledge to develop a suitable food product as an afterschool snack requires such specific knowledge as: • ingredients, health and safety, safe oven use, temperature, utensils, cost, mixing, measurements, nutrition, storage, an understanding of consumer preferences. Evaluation: • sensory evaluation, shelf life, cost, nutritional benefits, fitness for purpose.	*The health and safety link is to a website that identifies the issues in the context of preparing a hangi.*

CHARACTERISTICS OF TECHNOLOGY: SUPPORTING LEARNING ENVIRONMENT 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 technological developments that have and/or could expand human possibilities by changing people's sensory perception and/or physical abilities. Examination of technological developments should allow students to gain insight into how decisions are based on what could and what should happen.

support students to understand that expanding human possibilities can result in positive and negative impacts for particular groups of people, and the wider social and natural environment.

provide students with opportunities to examine and debate examples of innovative technological developments 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, and how what could happen and what should happen were considered.

support students to analyse a range of examples of technological developments and to identify the knowledge and skills that informed design decisions. Examples should be drawn from within their own and other technological practice and allow students to gain insight into the range of disciplines that can support technological developments.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Describe examples to illustrate how technological developments have expanded or have the potential to expand human possibilities and discuss the possible short and long term impacts of this.	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 in New Zealand include: • Hamilton jet boat • Buzzy bee • pavlova • electric fence • baby formula • bungy Jump	
	Review Visa Evolution ad and identify how technological developments have expanded human possibilities.	Visa evolution ad Watch the ad (1:03) and identify the opportunities that are provided through the use of the current versions of the technologies mentioned in the clip: cellphone, video, iPhone, computers (word processing) and EFTPOS and credit cards (and debit cards). Discuss current impacts and potential future impacts	
Discuss examples of innovative technological development to illustrate the role of creative and critical thinking.	Have students Google: 'tomorrow's technology' and find a New Zealand technological outcome that they can research and discuss.	Discuss a specific technology and the innovations that have enabled (or 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 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: SUPPORTING LEARNING ENVIRONMENT LEVEL 5

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

- support students to analyse a range of examples of technological developments to examine people's perceptions and/or level of acceptance has influenced the developments. Examples should be drawn from past, present and possible future technological developments to allow students to gain insight into the influence that perceptions and past experiences have on the acceptance of existing and future technological practice and outcomes.
- support students to analyse a range of examples of technological developments and to identify codified technological knowledge that was used to inform design and production decisions. Codified technological knowledge refers to such things as codes of practice, codes of ethics, intellectual property codes, codes of standards, material tolerances etc. Examples should be drawn from within their own technological practice and that of others.
- provide students with opportunities to discuss the role of codified knowledge in technology and understand why and how particular knowledge becomes codified. Codified knowledge serves to remind technologists of their responsibilities and provide them with access to established knowledge and procedures that have been shown to support successful technological development in the past. In this way codified knowledge can be used to provide constructional, ethical and/or legal compliance constraints on contemporary technological developments. Technological knowledge becomes codified when technological experts consider they have adequate evidence to validate it.
- support students to understand 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.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain how people's perception of and experiences with past technological developments (both in terms of practice and technological outcomes) influences their acceptance of technology.	Students brainstorm all the technological products they own or use.	The idea is for 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 idea is for students to realise that other generations have had different experiences with technology, and that this influences their relationships with new technology.	
	Watch an advert such as the Telecom XT ad and discuss if we should adopt this new technology.		
	Review future technologies and have students: • debate: "If people accept these technology(s), should they be developed and implemented?" • discuss what would need to change for the technology(s) to be accepted.	Use a science fiction movie extracts or trailers – see: www.fancast.com/trailers www.apple.com/trailers/genres/science_fiction/ Explore websites such as 'Future Technologies' to find an idea for a technology that is yet to be realised.	
Explain how people's perception of and experiences with past technological developments (both in terms of practice and technological outcomes) impact on future technological developments.	Forecasting future developments for everyday (familiar) products.	In groups, students choose an everyday technological product (such as phone, schoolbag etc) 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 past experiences.	
	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 the design ideas to wider stakeholders (parents, grandparents) and compare this feedback to the class feedback. Actively discuss (compare and contrast) any differences identified between the feedback and discuss possible reasons for this.	

Identify examples of codified technological knowledge and explain its role in particular technological developments.	Indentify examples of where and when codified knowledge is, and can be used.	Brainstorm different occupations and subcultures (such as surfers, computer geeks, electrician, gamers, etc). Discuss the codified knowledge that each of these groups uses.	
	Manage a class activity to support understanding of the purpose for codified knowledge (including graphic codes).	Students brainstorm questions about the value of codified knowledge. 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?	
	Examine 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 standard 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 that you are going to be working with the local daycare centre (such as making a movie, making, toys, furniture etc). Brainstorm some of the factors you would have to consider in this situation. Using understandings gained from the visiting technologist, discuss the technologist's 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.	Discuss where codified knowledge was used in the development of the outcomes and how this enhanced/hindered their technological practice in terms of their ability to: • communicate with their peers • record ideas.	
Explain how and why technological knowledge becomes codified.	Review a YouTube video of product failure or technological disasters (for example; Iran air, 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 from failure, lessons can be learnt that can lead to guidelines and codes to prevent failure in the future.	
	Individual students do a simple task (such as package an egg or drop an egg from a height) and then pass on knowledge of how it worked to others via text.	Students realise that codified knowledge is not only developed from failures (eg, knitting patterns, recipes, sewing pattern, skateboard, music genres).	

CHARACTERISTICS OF TECHNOLOGY: SUPPORTING LEARNING ENVIRONMENT 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 interdisciplinary technological developments and identify the impact the interdisciplinary nature had on the technological practice undertaken. Examples should be drawn from within students' own and other technological practice and allow students to gain insight into the way disciplines have been combined to support technological practice.

support students to identify 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 be drawn from within students' own and other technological practice and allow students to gain insight into the way idea generation and exploration can be enhanced through collaboration.

ensure students understand that interdisciplinary collaboration provides exciting opportunities to 'work at the boundaries' of established fields, however this may cause situations where no codified technological knowledge exists to guide practice, tensions between people may arise, and unknown consequences may result.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain examples of technological developments that are interdisciplinary in nature to demonstrate how the range of disciplines involved impacted on the technological practice.	Spend 15 minutes playing computer game. Brainstorm/discuss in pairs the different knowledge bases that may have been involved in the development of 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 outcome.	
	Present different examples of technological outcomes that are obvious results of collaborations For example: • tent – textile shell and resistant structure • electronic product – package design and electronic circuit design.	Discuss the links between material areas, common and specific knowledge and the attributes that involved successful collaboration.	
Explain examples of technological developments to demonstrate how collaborative practices of technologists have enhanced and/or inhibited technological developments.	Find an industry example or a case study that shows good collaborative practice between technologists, such as: • The Pixar story • www.melissaplasticdreams.com (Melissa shoe company collaborates with well known fashion/product designers and architects to develop new shoe products).	Individual or groups of students undertake an inquiry to identify the different disciplines involved and the collaborative practices adopted by technologists and then present their findings to class.	
	Students explore examples of where unsuccessful collaborative practices have led to product failure, such as: • YouTube – toy dog lips • YouTube – exploding ford • YouTube – Defibrillator	Students use knowledge gained of what makes a successful collaboration to determine examples of unsuccessful collaboration.	

CHARACTERISTICS OF TECHNOLOGY: SUPPORTING LEARNING ENVIRONMENT LEVEL 7

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

- support students to critically analyse examples of technological practice to gain insight into how technologists identify and deal with contestable issues and competing priorities. Examples should allow students access to such things as how changing attitudes, values and ethics, new and/or different knowledge and materials, impact on technologists' decision-making.
- support students to understand technology as a field of on-going contestation and competing priorities that require resolution through complex decision-making and balancing of resources against stakeholder needs and desires.
- guide students to recognise the role of functional and practical reasoning in complex decision-making.
- support 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 allows for innovative decision-making and resulting in innovative outcomes.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain technology as a field of on-going contestation and competing priorities and explain how this impacts on technological development.	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 contestations and competing priorities that impacted on these technologists technological practice.	
	View Techlink technological practice case studies, at: • 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 discussion on role of practical and functional reasoning in complex decision-making.	
	Arrange a technologist to visit the class to discuss decision-making.	The technologist could talk about their own process when making complex decisions, and answer students' pre-prepared questions that focus on identifying the competing priorities they had to address when developing their product.	
	Choose a technological product and investigate.	Discuss what complex decisions might have been made during the products development, eg, aesthetics and functional considerations, stakeholder desires.	
Describe examples to demonstrate how critical evaluation, informed creativity and boundary pushing impacts on innovative technological practice and/or technological outcomes.	What are boundaries and how do you push them?	Brainstorm and discuss with class. Class debate? • 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: SUPPORTING LEARNING ENVIRONMENT 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, intended and unintended) to gain insight into the social responsibility technologists have due to the interventionist nature of technology. Examples should enable 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.
- ensure students explore and discuss such things as the ethics of designing for limited technological outcome lifespan, designing to comply with minimal engineering ideals, utilising and developing sustainable materials, reducing energy consumption and waste, developing and managing socio-technological environments etc.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Discuss technology as intervention by design and use examples to demonstrate the impacts and implications of this.	Critically analyse case studies of technological developments such as: data storage, genetic modification, medicine, antibiotics, aviation, smart materials.	Teacher supports students to explore at the technological developments and their consequences (known and unknown, intended and unintended, short- and long-term). Students present findings to class and discuss.	
	Class debates the role and responsibility of a technologist.	Pose the following question of Victor Papanek as the subject of debate; 'Can designers, architects, and engineers 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.	
Describe examples to demonstrate how technology can challenge people's views of what it is to be 'human'.	Watch movies and/or YouTube 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 • Swimsuit design – Orca Company	
	Have students work in groups and produce a short skit/movie clip that challenges people's view of what it is to be human.		
	Have students to work in pairs/groups to choose a context (such as artificial intelligence, second-life gaming or genetic engineering), research that context and illustrate with examples.	Each group uses the research make a presentation to the class challenging people's views on what it is to be human. In their research/presentation students should cover: • ethics • minimal engineering ideals • sustainable materials • reducing energy consumption and waste • developing and managing socio-technological environments.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES

The examples of *teaching strategies* listed below are shown against specific curriculum levels, although many are appropriate at multiple 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 ensure that the *teaching strategy* adopted enables a focus on improving student abilities to 'justify').

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: SUPPORTING LEARNING ENVIRONMENT 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 guide them to recognise these as examples of technological outcomes developed by people to be a part of the made world.
- guide students to describe the physical nature of technological outcomes. The physical nature of technological outcomes refers to such things as size, shape, colour, smell, texture, components etc.
- guide students to describe the functional nature of technological outcomes. The functional nature of technological outcomes refers to what the outcome does.

Focused Learning	Teaching Strategy	Explanation	Modification/ Reflection
Explain that technological outcomes are made by people.	Discuss examples of technological outcomes.	Teacher gives examples of technological outcomes (and calls them technological outcomes) to encourage students to make a connection to people making outcomes.Whole-class or group discussion, possibly with teacher recording points on a flip chart/whiteboard, on the question: • How are/were people involved in this technological outcome?	
	Discuss the different people who make technological outcomes, eg, baker – bread.		
	A version of the Headbands game: • Students are in pairs, sitting so they cannot see each other. One has a technological outcome (product/system) that the other cannot see, and has to describe the object one clue at a time for the other to guess what it is. Clues are single statements about specific aspects of the outcome (function, physical nature, etc). The student describing gets one point per clue, more clues it takes the better because that means they are being very specific.	Example: A vivid marker Describe it in terms of its functional nature: • "It can write on lots of different surfaces." • "It cannot come off." • "It comes in different colours." • "It has a lid." • "It has a round/flat tip." Describe it in terms of its physical nature: • "It comes in different colours." • "It has a lid." • "The lid has grooves in it." • "The outside of it is made out of plastic."	
Describe selected technological outcomes in terms of their physical nature.	Descriptive wall chart/poster/literacy strategy.	Use common objects to regularly practice descriptive engagement. "I've got a (adjective[s] describing physical nature) outcome. Can you guess what it is?" Teacher to ensure language of size, shape, colour, texture, components are used. Teacher uses hidden object to support student understanding about physical nature of objects. Brainstorm strategy/ recording sheets.	
Describe selected technological outcomes in terms of their functional nature.	Descriptive wall chart/poster/literacy strategy.	"I've got an outcome that (phrase[s] describing functional nature). Can you guess what it is?" or "Have a look at this, what do you think it will do? Brainstorm strategy/ recording sheets. Over time, using a range known and unknown objects, encourage the discussion around their function.	*'Known' means students have heard about, might have seen, but not used. 'Familiar' means students have engaged with it and experienced it.*

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: SUPPORTING LEARNING ENVIRONMENT 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 other objects and guide them to identify which of these could be described as technological outcomes and 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, 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 technological outcomes and guide them to identify them as technological products or systems. Identifying an outcome as a product or system will determine 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 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 components within it and how they are connected.
- guide students to identify that link 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).

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain how a technological outcome can be distinguished from other things created by people.	Touchy feely bag or photos of known and unknown objects.	Students categorise objects into technological and non-technological outcomes.	
	Set up a photo/image activity, such as a street scene analysis.	Give students a photo of a street scene. They write two lists: one of technological outcomes and the other of non-technological outcomes. They have to explain/justify their lists.	A street scene is good because it often includes people, natural items (eg, grass) and things that challenge their thinking/ definitions (eg, fence posts, footpaths).
Identify the technological outcome as a product, and describe its physical nature in terms of the material it is made from.	Teacher has objects/objects aligned to the context for students to explore, and describe the technological outcome.	Set up series of objects with starter questions for students to explore. Starter questions focus on materials objects are made from. Ask students what alternative materials the object could have been made from.	
Identify the technological outcome as a system, and describe its physical nature in terms of the components and how they are connected.	Discussion about examples of systems.	Class considers a remote-control, wind-up or simple mechanical toy. Teacher leads discussion about input, output, components, and how the connections between components are important.	
Identify links between the physical and functional attributes of particular technological outcomes.	Physical and functional object matching game.	Use explored and contextual objects within the area/topic.	
	Venn diagram chart.	Create a Venn diagram chart to make connections between what something is made of, and what it can do.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: SUPPORTING LEARNING ENVIRONMENT LEVEL 3

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

- provide students with a description of the functional nature of a potential technological outcome and other details related to its use. Support students to generate potential options for the outcome's physical nature and explain which of these could be justified as fit for purpose.
- provide students with the opportunity to examine a range of technological outcomes with similar functional natures but with different physical natures and support them to understand that the intended use will determine which physical nature will be fit for purpose. For example, a selection of brooms could be described as having a similar functional nature (to sweep) but whether they are to sweep dust of the kitchen floor or water off the driveways will necessitate a different physical nature.
- provide students with the opportunity to examine a range of technological outcomes with similar physical natures but with different functional natures. For example, 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, and the physical nature options will set boundaries around what functional nature is feasible for a technological outcome at any time.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Describe possible physical and functional nature options for a technological outcome when provided with a need or opportunity.	If I (did such-and-such in development) the outcome would be XXX.	Have student focus on a specific technological outcome and complete the sentence, eg: if made it from metal it would be strong; if I made it from aluminum it would be light.	
	Present multiple problem scenarios to challenge students to think about possibilities in terms of physical needs and what an outcome will do in each context.	For example: If I want a mouth texture that is crunchy, what does the functional nature of the ingredients of the product need to be?	
Describe examples of technological outcomes with different physical natures that have similar functional natures.	Present multiple examples of similar products, but with different physical natures.	For example: • a range of raising agents – 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, painta a range of brushes – such as hair, paint, washing up.	
Describe examples of technological outcomes with different functional natures that have similar physical natures.	Explore functions of, eg, bags that are there to do similar things in terms of physical nature.	Cake, biscuit, bread – all three have similar functional natures, but each has a different physical nature, such as shape, outer surface, inner constitution, nature of raw mix etc.	
Explain the relationships between the physical and functional nature of selected technological outcomes.	Different products with the same functions	Picture charts, all used for similar purposes, how/why do these things connect together?	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: SUPPORTING LEARNING ENVIRONMENT 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 support 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 impacts. Impacts may be in terms of the outcome, the user, and /or the social and physical environment.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain the proper function of an existing technological outcome.	Question starters about a range of technological outcomes.	Object description: What is the outcome's intended use (proper function)? Open ended question starters: • What did we intend to use this for? • How do we know it's going to function in the way we intend? • How does it function to do that? Select an age-appropriate example that is context-specific to start with, then open ended.	
Describe examples that illustrate technological outcomes that have been successfully used by end-users for purposes other than what they were originally designed for.	Teacher and students discuss their own experiences.	For example: Kids who take things out of their father's shed and use them for things that they weren't intended for. Teachers: Describe a range of relevant common experiences and situations to students – for example, using a screwdriver to open a paint tin. Students explore different tools people use to do things – cracking nuts, opening a can, taking the top off a bottle.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: SUPPORTING LEARNING ENVIRONMENT LEVEL 5

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

- support 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 other technological practice and allow students to examine the criteria used to make the judgment.
- support 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 designed lifespan.
- support 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.

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 of a certain time period.	Brainstorm events/issues/values of the time period/decade and discuss how they influenced the products developed during that time.	
	Provide a range of examples of a technology as it has evolved over time, such as the cellphone.	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 for these.	
Determine if particular past technological outcomes would be considered fit for purpose if developed today.	Students to investigate an historical technology, such as the turntable, steam cars etc.	Students identify 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 and how such failures can inform future outcomes.	Brainstorm understandings of the term malfunction.	Identify personal experiences of technology malfunction.	
	Predict what the future could have been like if a popular technological outcome (eg, the USB drive, the laptop, antibiotics, Post-it notes) had malfunctioned.	If this product had malfunctioned in the past, how would it have informed future technological outcomes and our lives?	
Explain the cause of particular technological outcome malfunction and the resulting consequences.	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 or airline disasters. Many websites specialise in technology malfunctions, including: • 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: SUPPORTING LEARNING ENVIRONMENT LEVEL 6

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

- provide students with opportunity to describe 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 analyse and understand it.
- ensure students understand that if a technological outcome is identified as a product, the focus for describing its physical nature will be on the materials it is made from. If a technological outcome is identified as system, the focus for describing its physical nature will be on the components within it and how they are connected.
- support students to identify examples of socio-technological environments to examine how technological outcomes (products and systems) and non-technological entities and systems (people, natural environments, political systems etc) work together to ensure the environment is successful. 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 systems, recreational parks, factories, power-plants etc.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Explain that some technological outcomes can be perceived as both a product and a system.	Provide a scaffold in the form of a diagram that shows a technological outcome (eg, the iPod) as being described as both a system and a product.	Students diagrammatically identify the systems that make up a product such as the iPod	
Describes examples to illustrate how technological outcomes and non-technological entities and systems work together to create socio-technological environments.	Describe personal experiences of using associated systems and of using in a social context/interaction – eg, sharing music/ movies, recreational parks (Mahurangi, pest control gates).	Extend the diagram from single product to the supporting systems – for example, iPod: computer (updating and charging), iTunes store, music library, shareware, accessories. See store.apple.com/nz.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: SUPPORTING LEARNING ENVIRONMENT LEVEL 7

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

- support students to critically analyse the physical and functional nature of technological outcomes to identify what design elements have been prioritised. Support students to discuss why these prioritisation decisions may have been made with respect to the intended purpose of the technological outcome, the context of its use and the time of its development.
- support students to analyse examples of technological outcome malfunction to gain insight into how such events can impact on future decision-making in technology. Impacts can include such things as the decision to withdraw or modify the technological outcome, or retain the outcome with modified operational parameters. Wider impacts may also result, such as changes to codified knowledge and influences on the development of related technological outcomes.

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Discuss examples of technological outcomes to demonstrate how design elements have been prioritised and why these decisions enabled it to be fit for purpose.	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 enables a clear comparison to be made between the individual products.	
Describe examples of technological outcome malfunction to demonstrate how malfunction can impact on subsequent technological developments.	Find examples of where malfunction has lead to subsequent enhancement / modification of an outcome – for example, the baby buggy.	Give students an example of a badly designed outcome and a well-designed outcome (eg, baby buggies) and identify the differences.	

CHARACTERISTICS OF TECHNOLOGICAL OUTCOMES: SUPPORTING LEARNING ENVIRONMENT LEVEL 8

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

- support students to critically analyse a range of technological developments to interpret the fitness for purpose, in its broadest sense, of technological outcomes. The interpretation 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.
- ensure students understand that 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 (eg, such things as the sustainability of resources used, ethical nature of testing practices, cultural appropriateness of trialing procedures, determination of lifecycle and ultimate disposal).

Focused Learning	Teaching Strategy	Explanation	Modification/Reflection
Interpret the fitness for purpose, in its broadest sense, of existing technological outcomes and provide justification of the interpretation.	Develop a criteria for evaluating fitness for purpose.	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 • ethical nature of testing practices • cultural appropriateness of trialing procedures • determination of lifecycle and ultimate disposal. Test their criteria against familiar and/or unfamiliar technological outcome/s.	
	View/listen to an engaging video/talk/guest speaker justify the fitness for purpose of a technological outcome they have developed, eg, 'story of stuff' .	Students evaluate the justifications provided against the criteria they have developed above.	