STEM Learning Package

The impacts we envision

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Innovation is the unrelenting drive to break the status quo and develop anew where few have dared to go.

Steven Jeffes

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The best way to predict
the future is to create it.

Alan Kay

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The definition of insanity is doing the same thing over and over again, but expecting different results.

Albert Einstein

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There’s a way to do it better. Find it.

Thomas Edison

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Learning intention & student outcomes

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Design 2050

Students will imagine and design the ideal futuristic community for their locality. They may choose to focus on buildings such as homes, businesses, schools and hospitals or focus on larger planning such as towns, parks, cities, transport systems, etc.

While designing their solutions, students identify a clear focus on maintaining culture, improving health and wellbeing, designing sustainably and improving community connection. Their designed solutions will improve human inhabitation and co-habitation with their environment.

Every design must also consider and integrate the technological advances they foresee by the year 2050. To personalise their results, students create avatars of their future selves. They will communicate how they envision themselves within their designed future.

Now and in the future

In order to improve the existing design of their choosing, students must study the inefficiencies of the existing design and examine opportunities for innovation. Therefore, their learning evidence will communicate two aspects: the problem (as the now) and the solution (as the future).

As part of their design decisions, students must also incorporate an alternative use of material.

Through the study of science, students will examine a material within their existing design and substitute it for an improved version, therefore innovating their design through knowledge and application of science and technology.

Students investigate problems worth solving, such as:

- Lack of access, sustainability, community connection, flexibility to respond to climatic changes, cultural considerations and understanding
- Health associated problems
- Affordability
- Community member's lack of sense of belonging and ownership
- Discrimination and lack of inclusivity
- One size fits all approach and lack of diversity

Students may choose to study problems in the following areas:

- Residential housing design
- Transport systems design
- Major industry fields
- Schooling system
- Health system
- Waste system
- Public recreational areas design
- Products and produce design

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ACARA Learning Areas

Year 9 & 10 Design and Technology

Achievement standards: By the end of Year 10, students explain how people working in design and technologies occupations consider factors that impact on design decisions and the technologies used to produce products, services and environments. They identify the changes necessary to designed solutions to realise preferred futures they have described. When producing designed solutions for identified needs or opportunities, students evaluate the features of technologies and their appropriateness for purpose for one or more of the technologies contexts.

Students create designed solutions for one or more of the technologies contexts based on a critical evaluation of needs or opportunities. They establish detailed criteria for success, including sustainability considerations, and use these to evaluate their ideas and designed solutions and processes.

They create and connect design ideas and processes of increasing complexity and justify decisions. Students communicate and document projects, including marketing for a range of audiences. They independently and collaboratively apply sequenced production and management plans when producing designed solutions, making adjustments to plans when necessary. They select and use appropriate technologies skilfully and safely to produce high-quality designed solutions suitable for the intended purpose.

ACARA Learning Areas

Year 9 English

Productive modes (speaking, writing and creating)

Achievement standards: Students understand how to use a variety of language features to create different levels of meaning. They understand how interpretations can vary by comparing their responses to texts to the responses of others. In creating texts, students demonstrate how manipulating language features and images can create innovative texts.

Students create texts that respond to issues, interpreting and integrating ideas from other texts. They make presentations and contribute actively to class and group discussions, comparing and evaluating responses to ideas and issues. They edit for effect, selecting vocabulary and grammar that contribute to the precision and persuasiveness of texts and using accurate spelling and punctuation.

ACARA Learning Areas

Year 9 Science

Achievement standards: Students design questions that can be investigated using a range of inquiry skills. They design methods that include the control and accurate measurement of variables and systematic collection of data and describe how they considered ethics and safety. They analyse trends in data, identify relationships between variables and reveal inconsistencies in results. They analyse their methods and the quality of their data, and explain specific actions to improve the quality of their evidence. They evaluate others' methods and explanations from a scientific perspective and use appropriate language and representations when communicating their findings and ideas to specific audiences.

Pedagogical/Androgogical/Heutagogical Options

Cross-disciplinary learning package for:

- Enquiry-based Learning
- Project- and Problem-based Learning
- STEM-focused learning design

Provides teachers with resources for delivering the learning intentions against cross-disciplinary ACARA achievement standards.

Teachers are encouraged to provide students with self-directed learning opportunities rather than opting to deliver in traditional teacher-guided modes.

General capabilities

Critical & Creative Thinking

- pose questions
- identify and clarify information and ideas
- organise and process information
- imagine possibilities and connect ideas
- consider alternatives
- seek solutions
- put ideas into action
- transfer knowledge into new contexts
- apply logic and reasoning
- draw conclusions and design a course of action

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General capabilities

Literacy Capability

- understand how visual elements create meaning
- compose spoken, written, visual and multimodal learning area texts
- use language to interact with others
- deliver presentations
- express opinion and point of view
- listen and respond to learning area texts
- interpret and analyse learning area texts

General capabilities

Ethical Understanding

- recognise ethical concepts
- explore ethical concepts in context
- reason and make ethical decisions
- consider consequences
- reflect on ethical action
- consider points of view

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General capabilities

Personal & Social Capability

- appreciate diverse perspectives
- contribute to civil society
- understand relationships
- communicate effectively
- work collaboratively
- make decisions
- negotiate and resolve conflict
- develop leadership skills

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Entrepreneurial skills & dispositions

- Critical thinking and problem-solving
- Social intelligence
- Curiosity and inquisitiveness
- Perceptive awareness
- Communication
- Collaboration
- Remaining open to continuous learning and improvement
- Persisting
- Questioning and problem posing
- Recognise opportunities
- Creating, imagining and innovating
- Thinking and communicating with clarity and precision
- Thinking flexibly
- Adaptability
- Transferability: Applying past knowledge to new situations
- Resilience

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Time duration

Day’s challenge to full term’s study

Mode

Face to face | Online in synchronous & asynchronous learning

- Can be delivered across a collaborative class shared between English, Design & Technology and Science teachers

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Multi-disciplinary connections

English/Design & Technology/Science

Aspects of learning through this interdisciplinary STEM learning package provides students to develop the following skills, knowledge and dispositions:

- pose questions
- identify and clarify information and ideas
- organise and process information
- imagine possibilities and connect ideas
- consider alternatives
- seek solutions and put ideas into action
- transfer knowledge into new contexts
- apply logic and reasoning
- draw conclusions and design a course of action
- understand how visual elements create meaning
- compose spoken, written, visual and multimodal learning area texts
- use language to interact with others
- deliver presentations
- express opinion and point of view
- listen and respond to learning area texts
- interpret and analyse learning area texts
- recognise ethical concepts
- explore ethical concepts in context
- reason and make ethical decisions
- consider consequences
- reflect on ethical action
- consider points of view
- appreciate diverse perspectives
- contribute to civil society
- understand relationships
- communicate effectively
- work collaboratively
- make decisions
- negotiate and resolve conflict
- develop leadership skills

When you need to innovate,
you need collaboration.

Marissa Mayer

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None of us, including me, ever do great things. But we can all do small things, with great love, and together we can do something wonderful.

Mother Teresa

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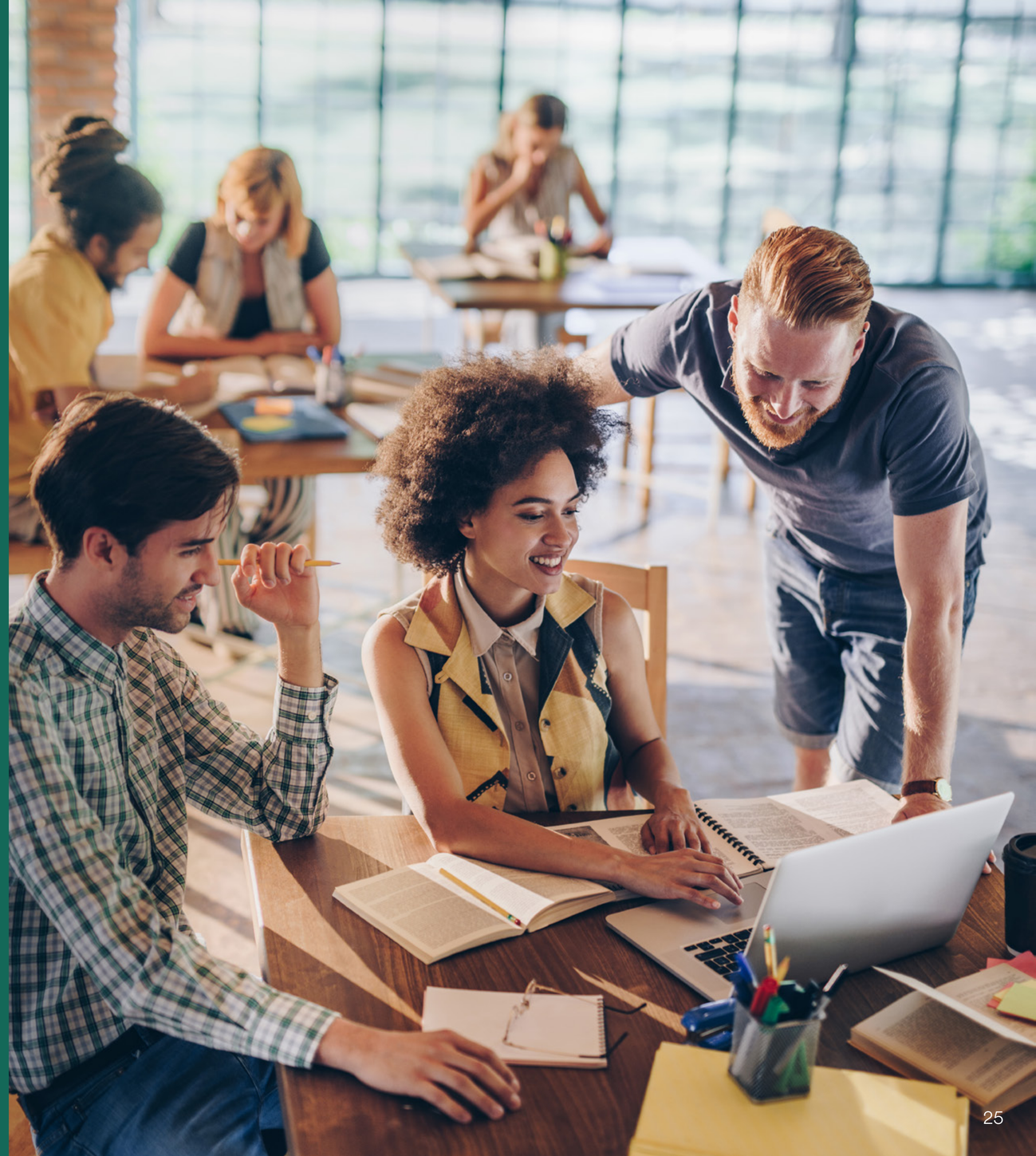
Lesson implementation



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Lesson aims

Students will select one of the existing problems within the following areas of study:

- Residential housing design
- Transport systems design
- Major industry fields
- Schooling system
- Health system
- Waste system
- Public recreational areas design
- Products and produce design

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Lesson aims

Students will investigate one of these issues in relation to the areas of study:

- Lack of access
- Lack of sustainability
- Lack of community connection
- Health associated problems
- Affordability
- Lack of flexibility to respond to climatic changes
- Community member's lack of sense of belonging and ownership
- Lack of cultural considerations and understanding
- Discrimination and lack of inclusivity
- One size fits all approach and lack of diversity

Individual work

Students collect primary and secondary data on existing issues within their selected area of study.

Students then produce a report showcasing the evidence of the need for change (issue) and summarise their findings through a written/verbal pitch.

Wherever possible, students engage with local government, town planners or relevant institutions/organisations to understand what the existing predictions and strategies are for preparing and growing the area into the future.

Students enquire about how these institutions and organisations envision their town.

Teaming up

Students present their reports and pitches to the class and use this as a way to group students based on their interests and passion. Students vote for the top three peer's issues they deem worthy of fixing and organise their working teams based on those votes.

Design 2050: Daydreaming

Students participate in an imagination exercise where meditation is combined with creativity. Each group finds a relaxing space and spend 10 silent minutes imagining the perfect [area of study].

After this exercise, students share all the ideas they had and brainstorm creatively to gain as many ideas as possible (quantity, not quality). Here, students are encouraged to be as crazy as they want.

SCAMPER

Fun idea-generation tool that activates divergent and creative thinking. The 7-letter acronym stands for: ‘Substitute, Combine, Adapt, Modify, Put to other use, Eliminate and Rearrange’. These are 7 strategies that provoke our brains to find alternative solutions to problems or existing products/systems.

To realise the full potential of SCAMPER as an ‘Ideation’ tool, it is important to set a safe learning environment that welcomes failure and promotes divergence. A cooperative and collaborative environment would be ideal. This can be achieved by using resources such as IDEO U’s 7 rules or brainstorming, the green hat from Edward de Bono’s ‘Six Thinking Hats’ or using ‘Yes and...’ as compulsory sentence starters.

SCAMPER was created by Robert F. Eberle in 1971 to integrate creativity in traditional classroom learning and help students think outside the box (Michalko, 2010).

The next slide is an example of how the students used SCAMPER to come up with Ideas for ‘better cohabitation between humans and the natural world’.

Some students picked components such as Transport, Housing, Waste, and other brainstormed areas that students considered to need re-designed improvements.

Substitute one thing for another

Example: Instead of using slabs to build on the ground where nature thrives, buildings could substitute concrete slabs with tall pillars

Combine with other functions, materials or things

Example: Bus stops are usually only used for people to wait. We could combine them with community gardens so that instead of waiting, people can care for plans and pick herbs on their way home. This will promote wellbeing and also help the bees live amongst us.

Adapt the design, so it can be used for some other purpose

Example: Humans spend lots of resources and energy in recycling glass when it could be designed differently in order to reduce the need for processing time and energy. We could adapt glass bottles to be shaped as modular bricks that can be used for building. The air inside would act as insulation and allow light in without much heat/cool transfer.

Modify, magnify, minimise elements of its design

Example: A large proportion of waste in the CBD's public bins are coffee cups. Can the bottom of the disposable paper cups be modified to become a hidden compartment with soil and seeds that can only be released open once the coffee is finished? The coffee cup would then become a herb planter that people want to keep. 'The plant-a-cup', the cup that keeps giving in their afterlife.

Put to other use; change the function or purpose

Example: An excessive by-product of the transportation industry are tyres. Exaggerated amounts of tyres are piled into mountain-sized landfills. At the same time, tyres are proven to be strong, flexible and highly durable. Why not use it as a building material for houses, playgrounds, roads, shoes, toys, roadside safety, etc.

Eliminate, elaborate, enhance some or all parts of the design

Example: Restaurants can eliminate plastic straws by using 'bucatini' pasta which is spaghetti that is hollow in the middle. Pasta is strong enough to not soften in cold beverages and is very fast to decompose and completely environmentally friendly.

Rearrange, reverse sections or move parts around

Example: Rearranging the direction of the water that falls on umbrellas: Can the handle of an umbrella be made into a bottle so that the top captures the water (instead of repelling it out) and the stick filters it on its way down to the bottle? Moving the parts around like this would help reduce purchases of bottled water.

Example 1

A group of students chose to study housing affordability.

After proving the problem is real by studying (primary and secondary sources) and generating a report and a pitch, these students then use SCAMPER to identify ideas that could work for an alternative affordable material to replace traditional building materials.

They undertake scientific investigation about the properties of car tyres, such as their structural integrity, fire resistance, affordability and accessibility to the region.

Students design solutions and start communicating their futuristic solutions through drawings, construction models, writing and visual designs.

Example 2

A group of students chose to study sustainability and health-associated problems related to human lifestyles within modern residential housing design.

After proving the issue is real by studying (primary and secondary sources) and generating a report and a pitch, these students then use SCAMPER to identify ideas that could work for an alternative lifestyle to replace traditional living conditions.

They undertake scientific investigation about the health benefits of tiny home lifestyle, such as their energy efficiency, resident lifestyle activities and affordability.

Students design solutions and start communicating their futuristic solutions through drawings, construction models, writing and visual designs.

Design solutions

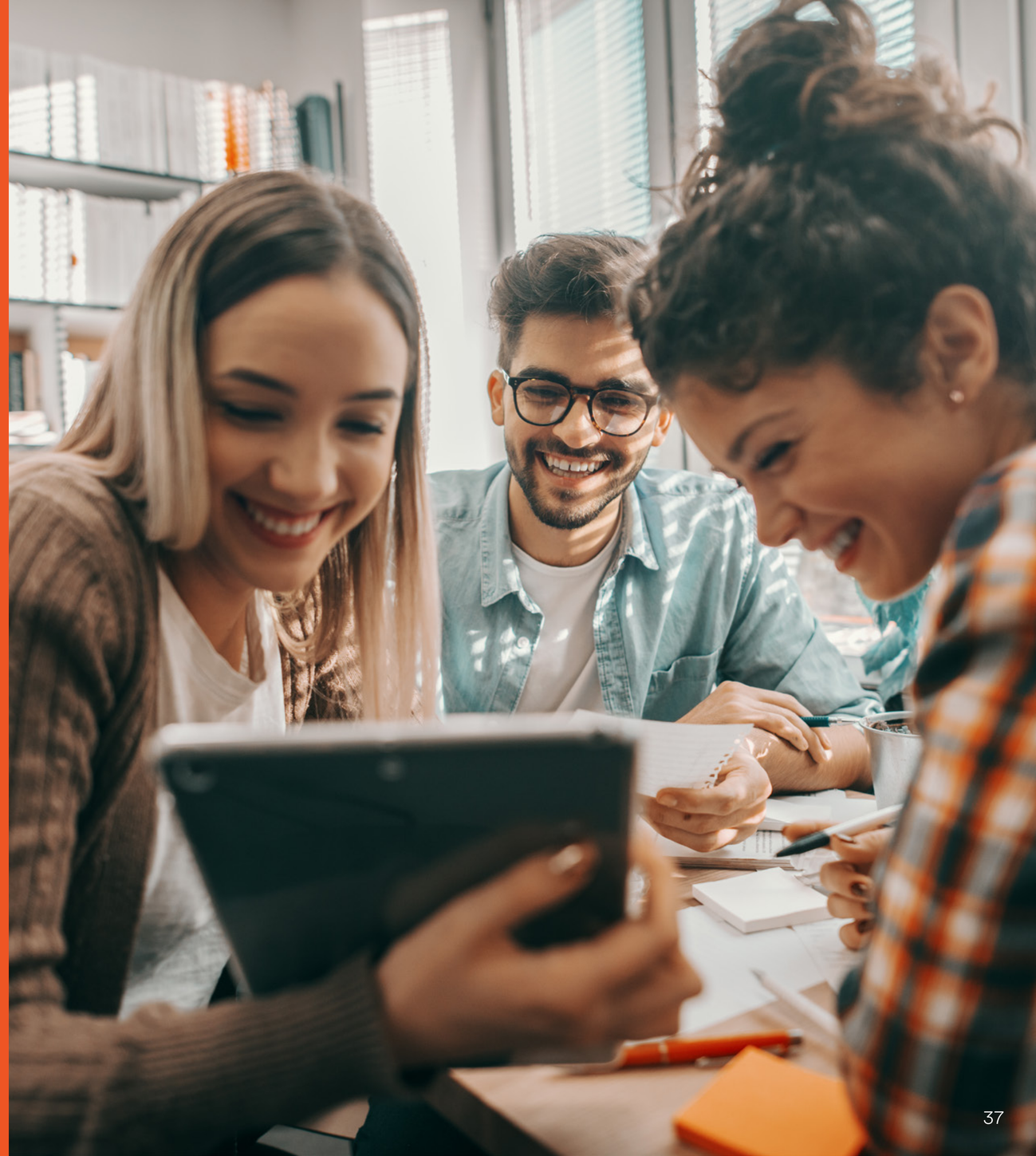
Students are encouraged to find a client who not only agrees with their identified problem but also experiences the issue. The client would then act as a feedback provider as they are the authentic user of the student's designed solution.

Students are encouraged to seek feedback to iterate their design at least three times.

Final solutions can be presented in a gallery style showcase. Students not only present their identified problem, their reports and pitches but most importantly, students present their learning journey as an empowering tool for their future, presenting the skills and knowledge they have gained throughout this learning package and actualising the applicability of such learning in the real world of work. They showcase their solution along with their designed iterations to highlight the growth and development of their ideas, skills and knowledge.

To personalise their presentations, students can create avatars of their future selves. They will communicate how they envision themselves in their designed future.

Resources



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Additional resources

- ETPG toolkit
- The Story of Stuff: Products and the issue of sustainability
- Housing and the issue of sustainability
- Top challenges for the future of humanity
- Global food supply
- Economic growth and social inclusion
- Environment and natural resources

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- The future of the global financial system
- Gender parity
- International trade and investment
- Infrastructure and development

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Content descriptors

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Design and Technologies

Knowledge and Understanding

- Critically analyse factors, including social, ethical and sustainability considerations, that impact on designed solutions for global preferred futures and the complex design and production processes involved (ACTDEK040)
- Explain how products, services and environments evolve with consideration of preferred futures and the impact of emerging technologies on design decisions (ACTDEK041)

Process and Production Skills

- Develop, modify and communicate design ideas by applying design thinking, creativity, innovation and enterprise skills of increasing sophistication (ACTDEP049)

Language & Literacy

Expressing and Developing Ideas

- Explain how authors creatively use the structures of sentences and clauses for particular effects (ACELA1557)

Interacting with others

- Use interaction skills to present and discuss an idea and to influence and engage an audience by selecting persuasive language, varying voice tone, pitch, and pace, and using elements such as music and sound effects (ACELY1811)
- Plan, rehearse and deliver presentations, selecting and sequencing appropriate content and multimodal elements for aesthetic and playful purposes (ACELY1741)

Science as human endeavour

Nature and development of science

- Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community (ACSHE157)
- Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries (ACSHE158)

Use and influence of science

- People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities (ACSHE160)

- Values and needs of contemporary society can influence the focus of scientific research (ACSHE228)

Questioning and predicting

- Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

Planning and conducting

- Plan, select and use appropriate investigation types, including fieldwork and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)
- Select and use appropriate equipment, including digital technologies, to collect and record data systematically and accurately (ACSIS166)

Processing and analysing data and information

- Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

Evaluating

- Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data (ACSIS171)

Communicating

- Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS174)

Note: Ideally, this learning package would be delivered by a teaching team consisting of an educator from each learning area. However, the learning can be delivered in a collaborative unit of at least two of these areas.

Jobs & industry

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Associated jobs of the future

The skills, knowledge and experience of undertaking this learning experience can equip students for the following jobs of the future.

Teachers can use this engagement tool to help students understand the relevance of this learning to their future world of work.

Net positive architects

Net positive architects will design building solutions to create viable and responsible commercial buildings or houses.

New materials engineer

New materials engineers will create innovative applications for cutting-edge materials and technology.

Digital implant designers

Digital implant designers will create body hacks that will be implanted into people's bodies and brains to ensure their health and enhance their lifestyles.

Trendwatcher

Trendwatchers will know what is likely to happen next, and how to make the most of it.

Fusionist

Fusionists will use design approaches to bring together professionals from art, engineering, research, science, and other disciplines to create innovative ideas, experiences, and solutions to complex problems.

Agroecological farmer

Agroecological farmers will grow crops and biofuel, while restoring agricultural balance.

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AI educator

AI educators will help people make the most of artificial intelligence, including learning how to use digital tools and data, and how to work with digital and robotic assistants.

Virtual and augmented reality experience creator

Virtual and augmented reality experience creators will design digital and virtual experiences for healthcare, marketing, or entertainment.

Additive manufacturing engineer

Additive manufacturing engineers will be responsible for making everything from satellite dishes to refrigerators.

Analogue experience guide

Analogue experience guides will help people unplug from digital life and reconnect with the natural world, without digital implants or augmented reality.

Automated transit system troubleshooter

Automated transit system troubleshooters will address potential problems that occur in a transit system almost entirely comprised of autonomous self-driving vehicles.

Human habitat designer

Human habitat designers will develop and design land and built environments to create effective living and working arrangements in large settlements.

Innovation manager

Innovation managers will seek out new methods and technologies to support innovative thinking environments in organisations.

Integrated ecology restoration worker

Integrated ecology restoration workers will undo environmental damage and restore the natural environment to a healthy state.

Behaviour prediction analyst

Behaviour prediction analysts will predict human and system behaviour based on data and algorithms.

Biofilm plumber

Biofilm plumbers will install and maintain coatings of biofilm onto the walls of sewerage and wastewater pipes and liquid composting bins.

Integrated home technology broker

Integrated home technology brokers will work with households to design home support solutions that include household robots, data management and privacy, body implants for family members, and home controls.

Biometric security solutions engineer

Biometric security solutions engineers will create individualised biometric signatures to use when accessing digital and physical access points, replacing online passwords and physical keys.

Biomimicry innovator

Biomimicry innovators will seek sustainable solutions to human challenges by emulating nature's engineering processes.

Bioprinting engineer

Bioprinting engineers will create viable tissue for human implants, using hardware and software associated with next generation 3D printers.

Sustainable energy solutions manager

Sustainable energy solutions managers will design energy generation, storage, transport, and use systems that are efficient, sustainable and safe.

Links with industry

Depending on the problem chosen, students can examine the effects and impacts of the problem on local businesses and communities. By researching and enquiring about these repercussions, students can come across opportunities to innovate and collaborate on real issues faced. Students may find their ideal clients through these local explorations. The ability to ideate and use creative thinking to help solve a problem affecting the community is an essential skill valued by current and future industries. Liaising with local members in their neighbourhoods, businesses, organisations, clubs or associations provides students with an increased potential to generate solutions that matter to someone.

Note: Use the ETPG tool '5 Steps to guide any classroom to identify and design a simple reciprocally beneficial interaction with industry and community' (Please see Additional Resources on page 36).

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