STEM Learning Package

The impacts we program

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Technology should be an important ingredient. It may be and should be used as a tool for social development.

Aleksander Kwasniewski

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Learning intention & student outcomes

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Overview

- Students will study the big world problems affecting humanity and choose and investigate one of them in depth. Students examine the impacts of their selected issue of concern, from a global perspective and down to a national, local and more specifically on a personal level.
- Through the learning of Digital Technology, English and Mathematics, students design and collaborate to present their programmed solutions through showcasing ‘The Impacts They Program’. The showcase exhibits students’ stories behind the programmed solutions.
- Students storify their chosen problem to evoke emotion in the audience and inspire activism for the area of concern. The audience helps teachers assess and provide student feedback by evaluating aspects of the student’s presentations.

- Students will know and understand the connections between the world's biggest problems and their influence on them. They will be able to communicate the impacts of their chosen problem through spoken language and programmed designs. Their product will be a representation of their learning, highlighting the evident realness of their selected issue in their own locality, and spotlight the urgency for change in their own communities' reach.

Challenge

Students develop two components in this challenge. A story about the problem and a designed solution addressing the problem scenario.

- Set up a hypothetical scenario communicating a relevant problem that exists related to hunger, alternative energy, disease, crime, helping wildlife or even routinely to carry out many tasks for people without the ability to do so themselves.
- Present your hypothetical scenario in an evocative story, inspiring action.

Example scenario

You may build a scale model of a farm where the farmers are getting old and whose kids have moved out into the big cities. Can you help your robot complete a task for the farmer? (watering crops, alerting of dried soil, an intruder alarm, or a seed dropping mechanism). Your final robot has to come with a story, a setting, the problem being addressed, evidence that the problem exists, a scene around the robot and a programmed action that solves the identified problem.

Note: Your story should be realistic and highlight existing evidence linking your chosen problem. Your solution should be presented in an automated mechanical or robotic solution using resources available to you such as super bot kits, lego robotics, STEM mechanics sets, Meccano kits, electronic blocks, Spheros, etc.

Think multidisciplinary! Problems by definition, cross many academic disciplines.

Lucas Remmerswaal

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Breakthrough innovation occurs when we bring down boundaries and encourage disciplines to learn from each other

Gyan Nagpal

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School systems should base their curriculum not on the idea of separate subjects, but on the much more fertile idea of disciplines... which makes possible a fluid and dynamic curriculum that is interdisciplinary.

Sir Ken Robinson

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ACARA Learning Areas

Year 9 & 10 Design & Technology

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

Achievement standards: By the end of Year 9, students explain how geographical processes change the characteristics of places. They analyse interconnections between people, places and environments and explain how these interconnections influence people and change places and environments. They predict changes in the characteristics of places over time and identify the possible implications of change for the future. Students analyse alternative strategies to a geographical challenge using environmental, social and economic criteria.

ACARA Learning Areas

Year 10 English

Spoken Productive modes

Achievement standards: Students show how the selection of language features can achieve precision and stylistic effect. They explain different viewpoints, attitudes and perspectives through the development of cohesive and logical arguments. They develop their own style by experimenting with language features, stylistic devices, text structures and images.

Note: Ideally, but not necessarily, the learning would be implemented via a collaborative teaching team including teachers from each learning area.

Pedagogical/Androgogical/Heutagogical Options

Cross-disciplinary learning package for:

- Enquiry based learning
- Project/Problem-based learning
- STEM-focused learning design
- Iterative design, valuing failure as stepping stones

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**: Generating ideas, possibilities and actions
- **Information & Communication Technology**: Creating and communicating
- **Ethical Understanding**: Exploring values, rights and responsibilities
- **Literacy**: Composing through speaking
- **Personal & Social**: Social awareness

Entrepreneurial skills & dispositions

- Recognise opportunities
- Problem posing
- Problem-solving
- Creativity
- Social intelligence
- Listening with empathy
- Curiosity and inquisitiveness
- Communication
- Collaboration

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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 Geography, English, and Design Technology teachers

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Presentation inclusions

All students must participate in the creation of:

A) Written & Spoken

- An identified problem
- Hypothetical story representing the problem
- Evocative speech communicating the issue

B) Programmed solution

- Scene for the story and the solution to be laid out
- Programmed solution to run with the presentation time

Communicate to make people care about things that you think should matter!

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Lesson implementation

Lesson aims:

- Familiarise students with the big world problems affecting humanity
- Understand the intended learning and learning objectives

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Part 1: Introduction

- Introduce students to the ‘Global Issues’ or ‘Big World Problems’ (BWP) that affect humanity [Please see Additional Resources on page 29].
- Explain to students that they will be selecting an issue to examine in-depth individually, as a group, or within the class. Students will ultimately explore the evidence of the selected issue in their own surroundings and the effects on themselves and the people around them.
- Students will design a believable, data-informing, hypothetical scenario containing a problem associated with their selected BWP. Students will program a small scale solution to the scenario using the available STEM kits.

Note: This lesson can be undertaken individually or per group, as per teacher discretion. The results of the scenarios and solutions will be presented in a collaborative exhibition of ‘The Impacts We Program’. Teachers may change the product to a collaborative video gallery or online (synchronous or asynchronous) presentation, depending on constraints. Content may be added about the specific software/hardware being used, such as STEM sets, super bot kits, Lego robotics, STEM mechanic sets, Snap Circuits, Meccano kits, Little Bits kits, Spheros, etc.

Playtime

Allow students to get familiarised with the software/hardware tools through unstructured and structured playtime.

Please note that most tool sets come with tutorials, practice activities that students can run themselves. If you are unfamiliar with the technology yourselves as a teacher, don't be afraid to partake in this playtime along with your students. You might find a few leaders who are willing to take the role of helpers to you and the class.

The aim of 'playtime' is to get students familiar with the tools without being discouraged by failure. Make the value of failure explicit, and even gamify quick-failing. Depending on your comfort with the tools, you may add a task for students (individually or in teams) to teach each other the learning they gained through playtime.

Part 2: Body & Content

- Students will select democratically as a class, in groups or individually (as per teacher discretion) the problem they would like to examine in more depth.
- Use the scaffold on page 9 of the ETPG toolkit to help students undertake contextual research from a global perspective to a personal viewpoint.
- When they arrive at the personal level of the scaffold, they interview each other and people in their inner circles using relevant questions regarding the effects of their chosen 'big world problem'.

Primary data: Students should collect data on the impacts and effects of the BWP in their immediate community. Students design data collection tools such as surveys or use quantifiable observations such as counting rubbish, counting birds or traffic.

Secondary data: Research should be done on the existing relevant and contextual information. This will help students make comparisons and create tools to capture the difference.

Part 3: Story-fying their findings

Based on their findings, students will share the problems found locally through the use of hypothetical stories. Making their stories hypothetical ensures that confidentiality and anonymity are maintained. It is important that students inspire trust by committing to confidentiality when investigating existing problems in their community.

Students will compose a story in which the problem is believable in order to use the knowledge and skills they have gained through 'playtime' to create a solution.

Note: Depending on time allowance, teachers may decide that the class will select one single story for everyone to program a solution.

Draft for feedback

Students make an initial presentation of their story and solution plans as a way to get feedback and improve their production. Although this step is just a practice run for feedback, students are encouraged to try evoking empathy amongst their peers through their story and solution plans.

Time is given for preparing the presentations and to start constructing a draft design of their page.

It would be ideal to have more than one iteration and provide students with the opportunity for further feedback to help them improve their final product.

Groups

Although this learning plan can be implemented on an individual basis by assigning a page per student (based on teacher discretion), if the work is undertaken in groups, jobs need to be distributed and group dynamics established.

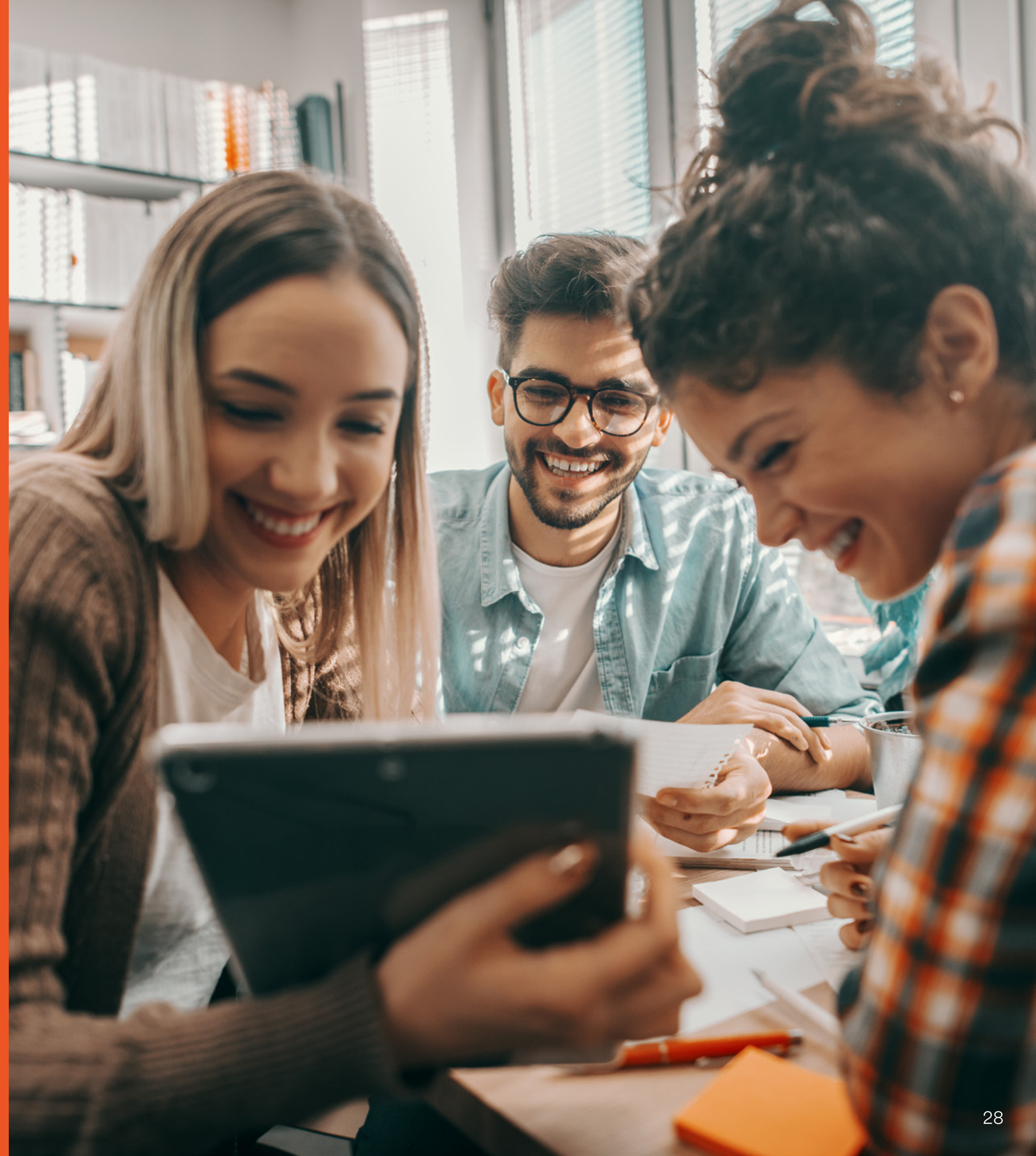
Prompt **groups** to:

- Identify group name, team members, and why each member cares about the issue they selected. They could also design a team logo, mascot or slogan, depending on time.
- Summarise their understanding of the ‘big world problems’.
- Allocate roles such as designer, writer, analyst or data engineer. You may wish to use the last slide on ‘Jobs of the future’ to help students understand the relevance of the work they are undertaking.
- Allocate jobs and responsibilities such as designing titles and editing images to each team member responsible for completing the tasks.
- Assign due dates for peer reviews, cross-group reviews, and feedback panels.

Part 4: Iteration of work, editing & compilation

- Students manage the collaborative creation of their exhibition by identifying design constraints to help all presentations flow seamlessly into one showcase.
- Students organise invitations, room layout, MC speaker, sound and printing, etc.

Resources



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Additional resources

- ETPG toolkit
- Global food supply
- Economic growth and social inclusion
- Environment and natural resources
- The future of the global financial system
- Gender parity
- International trade and investment
- Infrastructure and development
- Top challenges for the future of humanity
- Flinders University Mechanical & Engineering Kits

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Hybrid Thinking is a set of interdisciplinary and integrative thinking processes we will need to solve many of today's complex problems.

Pearl Zhu

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Multi-disciplinary connections

Design:

- Empathy (DT/E/G)
- Solution (DT/E)
- Creation (DT)

Communication:

- Spoken (E)
- Context (E/G)
- Problems (E/G)

DT: Design and Technology

E: English

G: Geography

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Content descriptors

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Design & Technology

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)
- Investigate and make judgements on how the characteristics and properties of materials, systems, components, tools and equipment can be combined to create designed solutions (ACTDEK046)
- Investigate and make judgements, within a range of technologies specialisations, on how technologies can be combined to create designed solutions (ACTDEK047)

Processes and Production Skills

- Critique needs or opportunities to develop design briefs and investigate and select an increasingly sophisticated range of materials, systems, components, tools and equipment to develop design ideas (ACTDEP048)
- Develop, modify and communicate design ideas by applying design thinking, creativity, innovation and enterprise skills of increasing sophistication (ACTDEP049)
- Develop project plans using digital technologies to plan and manage projects individually and collaboratively taking into consideration time, cost, risk and production processes (ACTDEP052)

Geography

Geographical Knowledge and Understanding

- *Environmental Change and Management*: Human-induced environmental changes that challenge sustainability (ACHGK070)
- *Geographies of Human Wellbeing*: Issues affecting the development of places and their impact on human wellbeing, drawing on a study from a developing country or region in Africa, South America or the Pacific Islands (ACHGK078)

Geographical Enquiry and Skills

- *Observing, Questioning and Planning*: Develop geographically significant questions and plan an inquiry that identifies and applies appropriate geographical methodologies and concepts (ACHGS072)
- *Interpreting, Analysing and Concluding*: Apply geographical concepts to synthesise information from various sources and draw conclusions based on the analysis of data and information, taking into account alternative points of view (ACHGS077)
- *Communicating*: Present findings, arguments and explanations in a range of appropriate communication forms, selected for their effectiveness and to suit audience and purpose; using relevant geographical terminology, and digital technologies as appropriate (ACHGS079)

English

Language

- *Language and Interaction:* Understand how language use can have inclusive and exclusive social effects, and can empower or disempower people (ACELA1564)
- *Expressing and developing ideas:* Refine vocabulary choices to discriminate between shades of meaning, with deliberate attention to the effect on audiences (ACELA1571)

Literacy

- *Interacting with Others: I*dentify and explore the purposes and effects of different text structures and language features of spoken texts, and use this knowledge to create purposeful texts that inform, persuade and engage (ACELY1750)
- Plan, rehearse and deliver presentations, selecting and sequencing appropriate content and multimodal elements to influence a course of action (ACELY1751)
- *Creating texts:* Create sustained texts, including texts that combine specific digital or media content, for imaginative, informative, or persuasive purposes that reflect upon challenging and complex issues (ACELY1756)

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.

Additive manufacturing engineer

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

Automation anomaly analyst

Automation anomaly analysts will help others to understand, improve, and refine solutions generated by AI.

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.

Chief digital augmentation officer

Chief digital augmentation officers will select the AI technology and other technological solutions (such as robotics and augmentations) for organisations.

Child assistant bot programmer

Child assistant bot programmers will design humanoid robots to provide children with education, supervision, and play.

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Digital implant designer

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.

DigiTech troubleshooter

DigiTech troubleshooters will work with households and businesses to solve problems with digital technologies that aren't easily fixable using at-home troubleshooting algorithms.

Energy and data systems installer

Energy and data systems installers will create intelligent home and office environments that are customised to optimise their energy use while continually learning and adapting to user behaviour.

Ethical hacker

Ethical hackers will identify weaknesses in cybersecurity systems to find and fix potential security risks and fight off attackers.

Gamification designer

Gamification designers will enhance user engagement of such things as nutrition, education, and exercise, by developing games.

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.

Machine-learning developer

Machine-learning developers will work with artificial intelligence to create and refine computer systems that learn new processes without human intervention.

Mechatronics engineer

Mechatronics engineers will build and optimise robots.

New materials engineer

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

Quantum computer programmer

Quantum computer programmers will use high speed computers to solve complex and novel problems.

Robot ethicist

Robot ethicists will address ethical issues associated with artificial intelligence, robots, cyborg technologies, and augmented/virtual reality.

Robot mechanic

Robot mechanics will maintain robots and autonomous vehicles to keep them running smoothly.

Satellite network maintenance engineer

Satellite network maintenance engineers will be responsible for keeping the global wireless satellite network functioning.

Shadowtech manager

Shadowtech managers will work in large organisations, managing technology that is used by employees but is not officially endorsed by the organisation.

Smart dust wrangler

Smart dust wranglers will program swarms of ‘smart dust’ to assist with surveillance, ecology restoration, and pollution control.

Links with industry

Depending on the problem chosen, students can examine the effects and impacts of the problem on local businesses. By researching and enquiring about these repercussions on businesses, students can come across opportunities to innovate and collaborate with industry on real issues they face. 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 businesses provides students with an increased potential to generate solutions that matter.

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 29).

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