Engineering Design

EDN215122

Course Implementation Guide

Department for Education,
Children and Young People

Tasmanian
Government

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Course Implementation Guide

Engineering Design (EDN215122)

About this document

This course implementation guide supports the course document[1]. It supports teachers to create active and engaging learning experiences.

The course document on the Office of Tasmanian Assessment, Standards and Certification's website must be used when planning, delivering and assessing this course.

The Department for Education, Children and Young People's A Pedagogical Framework[2] has informed this resource.

Focus area support

This is a Professional Studies course.

- In this course the Professional Studies focus area is an opportunity for teachers to integrate exposure to professional practice through excursions and activities, guest speakers and case studies relevant to engineering.
- Teachers should facilitate the making of links between expectations of professional practice and the learners own work and where they could, must abide by expectations, guidelines, etc.
- Activities should provide opportunities to develop engineering discipline specific skills alongside transferable skills key to the engineering profession, for example problem solving, analytical thinking, communication and presentation skills, interpersonal skills and project management, mirroring professional expectations and operating in a 'professional manner'.

Localisation and customisation

Localisation:

For providers with low numbers:

- This course requires learners to collaborate with others. This may be with peers, community members, and/or industry professionals.

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[1] A 'course document' refers to accredited course information on the TASC website.
[2] https://documentcentre.education.tas.gov.au/_layouts/15/DocIdRedir.aspx?ID=TASED-1629159896-383

For providers in isolated areas:

- Course context should be determined in relation to access to local resources and online opportunities to connect with other engineering design learners and industry experts.
- For providers delivering content remotely:
- Online and in person opportunities to connect with engineering design learners on other sites.
- Online and in person opportunities to connect with industry professionals.

For providers delivering multiple levels in a single class:

- Implementation of this course could occur alongside Engineering Design Level 3 course.

Customisation:

Opportunities exist to customise learning and content throughout the course. For example:

- providers choosing the engineering context(s) for the course delivery
- providers connecting to a particular context relevant to their local community
- learner agency – selection from a given range or negotiation of project topics
- provide adjustments to address formally identified needs, embedded learning adjustments and differentiated classroom practice within teaching and learning sequences
- flipped classroom/blended learning opportunities.
- In developing courses, providers must be careful to include appropriate learning activities that enable learners to develop the key knowledge and key skills identified in the learning outcomes for each module.
- Embedding practical activities throughout the course should be a major factor in designing a learning experiences, giving the learners ample opportunity to develop their understanding of the concepts within the context of real-world situations.

Course delivery advice

Table 1: Indicative Times

Module	Indicative Times
Module 1: Understanding the Engineering Design Process	50 hours

Module 2: Engineering Solutions	50 hours
Module 3: Negotiated Design Project	50 hours

Teaching and learning

Module 1: Understanding the engineering design process

The following learning outcomes are a focus of this module:

1. use design thinking to generate creative ideas in response to an engineering design challenge
2. apply an engineering design process in the development of prototypes
3. use project management strategies when working independently and collaboratively with others
4. apply an engineering design process to test, review and refine engineered solutions against success criteria
5. communicate engineering design decisions and solutions
6. describe the impact of existing, new and emerging technologies on people and engineering practice.

Module 1: Teaching strategies

Design underpins all engineering solutions. This module uses problem-based and project-based learning strategies to introduce learners to the principles of design thinking and engineering design processes.

This may take the form of several short engineering challenges, an extended whole class activity or a combination of both. These tasks should be appropriately scaffolded and explicitly provide learners with strategies for problem solving, project management and metacognition. The importance of working to a design brief within this engineering design process is pivotal.

Teachers should model and communicate that mistakes are an opportunity to progress learning and play a significant role in developing an innovator's mindset.

Learners should be supported to develop visual, written and oral communication skills to communicate their ideas and understanding through the process of design development and the presentation of a final solution or product.

Research skills are introduced in this module through the investigation of existing, new, and emerging technologies that impact the fields of engineering.

Where possible a team-based approach to solving problems fostering collaboration and enabling opportunities for peer feedback is encouraged.

Work requirements for this module include:

- an investigation of the impacts of existing, new, and emerging technologies, for example, the development of the mobile phone
- a project presentation and completed production diary in response to an engineering design challenge.

Please refer to Appendix 3 of the course document for further detail.

Module 1: Examples of learning activities

The why for learners

These activities describe how to help learners set goals and make connections:

Engagement through authentic design briefs and challenges:

- Provide learners with scenarios that have real-world context and a set of discussion questions.
- Provide learners with an interesting photo, picture or book and ask them to post questions and wonderings on a discussion board.
- Learners reverse engineer (safe disassembly) a physical product for example a hairdryer or torch, push toys. Learners follow a structured approach, to disassembly, using manufacturer's instructions and manuals where available. Learners will need to consider safe use of appropriate tools for example screwdrivers, pliers, cutters, spanners and measuring equipment. Learners document each stage of the disassembly.
- Learners investigate a disruptive technology, for example Smart phone, the wheel, biro, and share with the class how these changed the way we live.
- Learners research great engineering disasters and what could have helped to prevent the disaster.

The what for learners

These activities describe how to help learners to grasp big ideas and key understandings, make links to prior learning and organise new information:

- Keep an ongoing visual diary in which to stick inspirational pictures with annotations and initial sketches.
- Mini design challenges:
- Rapid prototyping (prototype – review – refine and iterate).
- Design and prototype footwear for overseas travellers in hot tropical countries where the Zika virus is present.
- Use a microcontroller, motors, and mechanisms to make a robot that moves like a living creature.
- Design a prosthetic for an athlete who does not have the use of one of their legs to enable them to participate in their favourite sport (your group can select which sport).
- Participate in a class debate on the topic - What is good design?
- Find images or drawings that represent each of the Design Elements and Design Principles.
- Create and use a decision matrix to evaluate a design.
- Design, print and display posters that effectively illustrate the safe and appropriate use of workshop equipment, including risk reduction and management. Teacher allocates learners the different workshop equipment to be researched.

The how for learners

These activities describe how to support learners to create, transfer and deepen knowledge and understanding:

- Interview a designer or engineer - discuss clients for whom they have provided solutions, comparing the nature of the tasks and the methods used throughout the design process. Discuss how design details of the brief are developed and documented and how these have influenced the designers' design process and decisions made.
- Use a template to formulate a design brief that addresses the problem/need/opportunity/situation and discuss how to develop meaningful evaluation criteria from the brief that include both qualitative and quantitative aspects.
- Design a simple device and pass it on to another class member to improve your design. Pass on again so that you have 3 different designs to test.
- Design a piece of furniture to occupy a particular room or space in your school that is inspired by a famous architect Cardboard furniture design challenge.

- Use production skills for example soldering, cutting coding etc. to produce and test a prototype.
- Create an instructional video of the computer-aided design (CAD) or computer aided-manufacturing (CAM) process for 3D printing for use by your school.
- Draw plans to scale for another class member to build.

Module 1: Focus area guidance

Exposure to professional practice

- engineering design challenges
- managing projects
- investigating existing, new, and emerging technologies.

Ideation, research, discovery, and integrated learning

- design thinking and engineering design processes.

Production and sharing replicating professional paradigm

- communicate with purpose
- solve problem
- prototype
- collaborate
- use a design journal.

Module 1: Recommended resources

- Project-based learning infographic (website - Department of Education NSW)
- What is an engineer and what does an engineer do? - What is Engineering? (YouTube 4:17min)
- Types of Engineering (website)
- The Biggest Problems We're Facing Today & The Future of Engineering: Crash Course Engineering #46 (YouTube 10:24)
- Crash Course Engineering YouTube Playlist (46 episodes)

- Thinking like a designer! - How to solve problems like a designer (YouTube 4:50min)
- What is Engineering and What is Design? (website)
- Stanford d.school (website)
- The 5 Stages in the Design Thinking Process (website – article)
- Engineering for Good - poster
- The Engineering Design Process: A Taco Party (website)
- The James Dyson Foundation (website and downloadable resources)
- Challenge Cards
- Engineering Design Process (website)
- A brief overview of the 5 phase Design Thinking process (YouTube playlist)
  - Design Thinking & Doing
  - Empathize
  - Define
  - Ideate
  - Prototype
  - Test
- Ideation tools – (website) - round robin, opposite thinking, mash-up method, analogy thinking, rip and rap, brainstorm cards, collaborative sketching, storyboarding)
- Rapid prototyping Google Glass – Tom Chi (YouTube – 8:08min)
- Sketch like an Engineer #1 Intro to hand sketching (YouTube 8:08min)
- Sketch like an Engineer # 2 Orthogonal Drawing (YouTube 7:53min)
- Research existing, new and emerging technologies - opportunities for incorporating cross-curriculum priority – Aboriginal and Torres Strait Islander Histories and Cultures The Orb - Living Cultures (website) eg shelters, stone tools, fibres
- List of some Australian Inventions and Innovations (website)
- The Evolution of Kitchen Appliances Overtime (website)
- The Future of Making Things (PDF eBook APAC Learner Project Showcase)
- Introduction to CAD: Learn Fusion 360 in 90 minutes (free account)

Module 2: Engineering solutions

The following learning outcomes are a focus of this module:

1. use design thinking to generate creative ideas in response to an engineering design challenge
2. apply an engineering design process in the development of prototypes
3. use project management strategies when working independently and collaboratively with others
4. apply an engineering design process to test, review and refine engineered solutions against success criteria
5. communicate engineering design decisions and solutions
7. describe the roles and responsibilities of engineers.

Module 2: Teaching strategies

This module enables learners to:

- deepen their knowledge of design and engineering processes
- apply learning in different and creative ways.

A variety of tasks should be provided. Each task should allow learners to demonstrate the key knowledge and skills outlined. Tasks should facilitate choice and flexibility. They should be clearly linked to the selection of strategies to progress toward and achieve specific standards. Learners should be actively involved in designing and constructing learning activities. Certain tasks are more suited to showing specific knowledge and skills. Tasks do not have to be lengthy or extensive to elicit evidence of learner achievement.

Providers should use worked examples to demonstrate how to undertake a learning task and ways to progress. This can occur at different points in a learning experience. When introducing unfamiliar tools and equipment:

- safe practices and maintenance procedures should be modelled
- risk assessment and incident responses should be explicitly taught.

Feedback should be timely and specific and structured to support growth and achievement. Feedback should support learners to reflect on and refine their understanding. Feedback from a variety of audiences is encouraged, including peers, community members and industry experts.

Work requirements for this module include:

- a poster or infographic identifying the key characteristics of engineers, describe how these characteristics apply to the engineer's role in a particular engineering context for example civil engineering, software engineering
- a learner selected engineering design project and accompanying design journal.

Module 2: Examples of learning activities

The why for learners

These activities describe how to help learners set goals and make connections:

- Research what engineers do. What are their roles and responsibilities?
- Use an ideation strategy that is mind mapping, to brainstorm solutions to a problem for example how could a building or product you use every day be redesigned to work better for people with disabilities?
- Watch the TedTalk by Simone Giertz Why you should make useless things (YouTube 11:58). With a partner, brainstorm your own "useless thing". Share with the class. Facilitate a discussion in relation to the role of failure in innovation and the innovator's mindset.

The what for learners

These activities describe how to help learners to grasp big ideas and key understandings, make links to prior learning and organise new information:

- Use a micro: bit to create a prototype for a personal heart monitoring system. The system must use an accelerometer to detect the movement of the heart. It must also use a suitable sound output and an LED display to give heart rate information to the user.
- How might we reduce reliance on single-use plastic in our community? Principles of Design Thinking (Autodesk Design Academy – free account).
- Investigate, prototype and test the best wing design for a remote-controlled survey aircraft (BP, the Science Museum and STEM Learning The Ultimate STEM Challenge).
- Design and construct a returning boomerang which will allow for the greatest flight distances relative to the accuracy of boomerang return (NASA The Great Boomerang Challenge).
- Interview a designer or engineer. Discuss clients for whom they have produced solutions, comparing the nature of the task to the methods used throughout the design process. Discuss how details of the brief are developed and documented and how these have influenced the designers' design process and decisions made.

- In teams, develop a design brief for the creation of an engineering solution and identify evaluation criteria for the problem/need/opportunity/situation. Conduct research and document three different design options using annotated drawings. Using a table (docx - 72.31kb), evaluate each proposed design option and determine which option best meets the design brief. Produce a work plan detailing the production of the option for the preferred solution (VCAA).
- Discuss how both qualitative and quantitative data play an important role in Engineering. Discuss how both types of data can help to provide a complete picture of the effectiveness of the engineered solution developed.
- Conduct an experiment for example investigate how to make biodegradable plastic from banana peels; the best material to put in a sandbag to block water during a flood; what type of paper airplane flies the fastest and stays aloft the longest.
- Using three different products that have the same primary function, learners develop a set of evaluation criteria to compare and contrast the function, ease of use, safety and suitability of materials. They draw conclusions about the function, ease of use, safety and suitability of materials and present findings using presentation software, for example PowerPoint, to the class (VCAA).
- From a given product for example children's toy, create a persona profile that identifies the user requirements.

The how for learners

These activities describe how to support learners to create, transfer and deepen knowledge and understanding:

- Use computer-aided design (CAD) software (such as SketchUp or AutoCAD) to draft designs for parts of an engineered system. If possible, 3D print these parts and then refer back to testing, modelling and design brief to evaluate them for effectiveness (VCAA).
- Use a Gantt chart to map the stages of a production plan in a sequence of steps or operations. There are many free Gantt chart templates available online, for example, GanttProject and TeamGantt.
- Discuss, as a class, why testing is important to the engineering design process. Design and carry out a testing procedure. Teacher then demonstrates how to prepare a report that explains the probable reasons for a performance problem, failure or breakage in an

engineering system. Watch the NASA YouTube clip entitled ‘Repeatability’ before discussing the importance of conducting tests several times to replicate results (adapted from (VCAA).

- Produce a 30 second video snapshot submitted via a LMS at the end of each lesson reflecting on team dynamics, things that went well, problems to be solved, etc.
- Participate in opportunities for work exposure for example industry career days, presentations from industry professional talks, mentorship, industry developed competitions or design challenges.
- The following are examples of approaches to delivery which could be used to enhance the learners understanding of the vocational importance of engineering design (WJEC Level 1/2 Award in Engineering).
- A health care facility supporting people with Parkinson’s disease is looking for a design solution for a computer keyboard. Learners meet with representatives to discuss their requirements and, in small groups, design a solution. They present their ideas orally, together with sketches and a ‘mock-up’ to potential users for feedback.
- As a result of feedback from customers, a retailer is introducing a new product range for its camping department. It has asked for a table and set of four chairs to be designed that can be stored in a box the size of a microwave. Learners visit the retailer to investigate the range of products that are sold. They then present their ideas to the retailer.

Module 2: Focus area guidance

Exposure to professional practice

- respond to and create engineering design briefs
- manage projects, including identifying objectives, setting targets and timescales, managing resources and carrying out risk assessment
- understand and apply professional standards such as ethical conduct, safe work practices and fundamental principles of intellectual property rights and protection
- investigate roles and responsibilities of engineers.

Ideation, research, discovery, and integrated learning

- design thinking and engineering design processes.

Production and sharing replicating professional paradigm

- communicate with purpose

- assess and develop engineered solutions
- collaborate
- use a design journal
- produce engineering reports.

Module 2: Recommended resources

- 10 Useful Approaches for Formative Assessment (image)
- ATLASSIAN Team Playbook (website - free workshop resources that is agile teams, elevator pitch, disruptive brainstorming, customer journey map, decision making framework, empathy mapping, inclusive meetings, learning circle, project poster, roles and responsibilities, retrospective)
- Design Brief – (YouTube 3:33min)
- Indigenous Engineers Group (website)
- Stories of Indigenous Engineering (website – Engineers Without Boarders Australia)
- Engineering Design Project Guide (website)
- Design Problem Statements – What They Are and How to Frame Them (website)
- Ideas for Engineering Science Fair Projects (online article)
- Scale drawing Khan Academy (website)
- Interpreting a scale drawing Khan Academy (website)
- 7 Everyday Items Transformed into Life Changing Innovations (website)
- Pathways for a career in Space (website Australian Space Discovery Centre)
- Biomimicry (website Biomimicry Institute)
- Youth Challenge Design Brief (PDF)
- Code of Ethics and Guidelines on Professional Conduct (website Engineers Australia)
- Stage 1 Competency Standard for Professional Engineer (website Engineers Australia)
- Competitions supported and run by industry, non-profit organisations, governments and universities for example National STEM Competitions (website)

Module 3: Negotiated projects(s)

The following learning outcomes are a focus of this module:

1. use design thinking to generate creative ideas in response to an engineering design challenge
2. apply an engineering design process in the development of prototypes
3. use project management strategies when working independently and collaboratively with others
4. apply an engineering design process to test, review and refine engineered solutions against success criteria
5. communicate engineering design decisions and solutions
8. explain how engineering solutions are utilised and their impact on society.

Module 3: Teaching strategies

Learners will be responsible for proposing a final engineering design project. As with the previous modules, they will:

- conduct their own research
- design and construct a prototype
- perform an evaluation of their final product.

Providers should develop protocols with learners to guide sharing, collaboration, construction and co-agency.

Learning is primarily learner directed and the teacher is a guide and facilitator. Direct instruction mini lessons may be required to:

- develop technical skills
- reduce project fatigue
- bridge a knowledge gap.

Direct instruction may include optional workshops, use of curated resources, pre-recorded tutorials, class discussions or guided experiments.

Ongoing feedback and reflection opportunities will be crucial to:

- guide learners through their negotiated projects
- support learners to self-regulate and build resilience to overcome challenges

- facilitate progression.

Questions that probe learners' thinking and prompt them to explain, explore and justify their choices should be used. This will help:

- develop connections between prior learning and new knowledge
- challenge misconceptions
- provide stimulus for further investigation.

Work requirements for this module include:

- Negotiated engineering design project.
- The process that learners have followed must be documented in a production diary. The production diary must be presented as a design folio, including:
    - Problem identification and analysis
    - Project plan
    - Iterative testing plans and implementation
    - Where the engineering solution could be used in society, the impacts it has, and how those impacts are managed.
- This is to be presented in an appropriate format including evidence of design development sketching and annotated photos of production process and documentation of testing processes.

Module 3: Examples of learning activities

The why for learners

These activities describe how to help learners set goals and make connections:

- Learners may independently identify and negotiate their own projects or develop ideas based on a choice of problem statements or design briefs.
- Example Problems and Solutions providing guidance around size and scale of problems and solutions are available in the Engineering Design Microsoft Teams channel.

The what for learners

These activities describe how to help learners to grasp big ideas and key understandings, make links to prior learning and organise new information:

- Learners identify and investigate design needs. They research and assess existing products to gain an understanding of how others have resolved similar problems, needs or opportunities, and then prepare a design brief that will establish the requirements of a product that they will design and make.
- Document a daily work log/time sheet including record of production with photographs of each stage of the production.
- Test and evaluate your finished product by responding to evaluation questions.
- Collaborative Projects - Utilise online platforms to enable all group members, and teacher, to have access to each other's research, planning, inputs. Group members are not dependent upon teammates being present each lesson for the project to progress.
- Watch TED's We can help you master public speaking \ Chris Anderson (YouTube 4:29) and facilitate a class discussion.
- Hold an elevator pitch workshop. Provide learners with a client brief/scenario and in small groups ask them to workshop and then before the end of the lesson pitch a project idea in the time it takes to ride an elevator.

The how for learners

These activities describe how to support learners to create, transfer and deepen knowledge and understanding:

- Learners extend and apply their knowledge and understanding within an engineering design project of genuine interest. Learners may collaborate with others in the class or seek to connect with community projects, industry professionals or not for profit organisations with provider guidance and oversight. Examples can be found Cambridge Nationals Level 1/2 Engineering Design Specification.

Module 3: Focus area guidance

Exposure to professional practice

- develop an engineering design brief
- manage projects
- consider the needs of the present with the needs of future generations.

Ideation, research, discovery, and integrated learning

- design thinking and engineering design processes.

Production and sharing replicating professional paradigm

- communicate with purpose
- appraise, design and create engineered solutions
- collaborate
- produce an engineering design report.

Module 3: Recommended resources

- Victorian Department of Education and Training – Literacy Teaching Toolkit – Extended writing piece: A design brief (website)
- Clean Energy Council – Technologies (website)
- Engineering a Sustainable World – Educator Toolkit (PDF)
- What is PBL? (website)
- Direct instruction is still necessary in a PBL classroom (website)
- What growth, innovation and collaborative mindsets look like for learners and teachers (website)
- Guide for giving a group presentation (website)
- Communicating Your Project Results with Professional Posters (website)
- The change-maker's guide to pitching your project idea (Online article)
- Teacher guidance during science investigations and engineering design (PDF poster)
- STELR Modules (website ready-to-use STEM resource)

Supporting learner responses

The work requirements outlined in the course document describe the fundamental assessment evidence. Inclusion of other tasks may support and enhance learning. Learning activities aim to support and enrich understanding and achievement of the learning outcomes. Possible strategies to support learner responses to work requirements are provided.

Module 1: Understanding the engineering design process

Work requirement 1 of 2

Title: research task – existing, new and emerging technologies

Context:

Investigation of the impacts of existing, new, and emerging technologies, for example, the development of the mobile phone.

- Produce a report – written, oral or multimodal.

Relevant learning outcomes

3. use project management strategies when working independently and collaboratively with others
5. communicate engineering design decisions and solutions
6. describe the impact of existing, new and emerging technologies on people and engineering practice.

Scaffolding

- provide a selection of technologies for learners to choose from
- provide some websites as jump off points
- provide graphic organisers and model how to use them for example a flow chart
- explicitly teach how to use the internet for research including referencing. Note if you have access to a teacher librarian, they may be able to support this by running a session on researching and academic integrity.

Work requirement 2 of 2

Title: Engineering design challenge

Context:

Through this area of study, learners develop an understanding of effective teams and how they as individuals, contribute to team success. They will also develop skills in project management within specific constraints such as resource and time.

Learners will document their experiences using a production diary or equivalent for example a folio or blog to capture their design process including ideation, sketching and annotated photos.

Learners will present an engineering design challenge response detailing their design process journey and produce an individual reflection on teamwork and project management.

Relevant Learning Outcomes

1. use design thinking to generate creative ideas in response to an engineering design challenge
2. apply an engineering design process in the development of prototypes

3. use project management strategies when working independently and collaboratively with others
4. apply an engineering design process to test, review and refine engineered solutions against success criteria
5. communicate engineering design decisions and solutions.

Scaffolding

- develop design briefs and challenges that are guided by learner interest within the engineering context(s) chosen by the provider
- breakdown challenge into smaller parts
- provide a template for learners to document their design process
- provide templates and exemplars for project management
- explicitly teach the language of cognition and metacognition
- provide opportunities for learners to engage in feedback with their peers.

Module 2: Engineering solutions

Work requirement 1 of 2

Title: Roles and responsibilities of engineers

Context:

- Identify the key characteristics of engineers, describe how these characteristics apply to the engineer's role in a particular engineering context that is civil engineering, software engineering.
- Produce a poster or infographic.

Relevant learning outcomes

3. use project management strategies when working independently and collaboratively with others
5. communicate engineering design decisions and solutions
7. describe the roles and responsibilities of engineers.

Scaffolding

- engage speakers to talk about engineering careers
- provide a list of useful websites

- provide material for exploration such as the Careers in STEM magazine
- provide a poster template
- provide hints and tips for creating an infographic in Word or PowerPoint.

Work requirement 2 of 2

Title: Learner-selected engineering design project

Context:

Learners are required to keep a journal to document the elements of the engineering design process as they develop their chosen engineering solution including:

- a description of the science, technology, and mathematics, using scientific symbols, diagrams, and formula where appropriate, that is used to explain the key function of the engineering solution
- a plan to collect data to assess the solution
- data collected and represented to enable interpretation
- reasoned conclusions made from the testing process using scientific, technological, and mathematical theory and the data collected
- identification of relevant professional standards and the role of enterprise.

It is expected that this process will form an inquiry cycle where the application of science, technology and mathematics is used to inform choices including data collection, and refinements are made through an iterative process. The completed diary entries should reflect this process and document the learner's evolution of knowledge and exploration, including the role and value of failure when engineering systems do not behave as expected.

Relevant learning outcomes

1. use design thinking to generate creative ideas in response to an engineering design challenge
2. apply an engineering design process in the development of prototypes
3. use project management strategies when working independently and collaboratively with others
4. apply an engineering design process to test, review and refine engineered solutions against success criteria
5. communicate engineering design decisions and solutions
7. describe the roles and responsibilities of engineers.

Scaffolding

- activate prior knowledge (questioning, K-W-L chart, etc)
- structure lessons to ensure learners clearly understand expectations and can confidently complete the activities required to work toward completing their project
- provide timely feedback and promote reflection and self-assessment
- enable opportunities for peer-to-peer feedback and time for learners to reflect and act upon feedback
- support effective group work with project management tools
- embed assessment throughout the project. Strategies could include exit tickets, 30 second video snap shots submitted via a LMS each lesson, message board discussions, strategic questioning, one-minute papers.

Module 3: Negotiated design project

Work requirement 1 of 1

Title: Negotiated engineering design project

Context:

Design and production of an engineered solution to a specified project brief as provided by the course instructor. The process that learners have followed must be documented in a production diary. The production diary must be presented as a design folio, including:

problem identification and analysis:

- clear statement identifying the problem
- in depth analysis of the problem including:
    - identification of stake holders
    - identification of existing solutions.

Project plan:

- projected timeline
- initial designs and thoughts on a new solution
- prototype and appropriate documentation
- analysis of chosen design

- identification of flaws in design
- suggested improvements given ideal circumstances.

Iterative testing plans and implementation

- documenting each step of each cycle of the Engineering Inquiry Cycle.

This is to be presented in an appropriate format including evidence of design development sketching and annotated photos of production process and documentation of testing processes.

Relevant learning outcomes

1. use design thinking to generate creative ideas in response to an engineering design challenge
2. apply an engineering design process in the development of prototypes
3. use project management strategies when working independently and collaboratively with others
4. apply an engineering design process to test, review and refine engineered solutions against success criteria
5. communicate engineering design decisions and solutions
8. explain how engineering solutions are utilised and their impact on society.

Scaffolding

Selection of appropriate scaffolding will depend on the selected projects and the needs of the learners:

- ensure negotiated projects connect to learner interest
- make graphic organisers/mind maps available
- use exemplars and rubric to model expectations
- create opportunities for learner conversation/discussion
- provide ongoing feedback throughout the project.

Additional support resources [3]

- Course Document

[3] All resources cited were accessed and checked for accuracy and appropriateness of content in October 2022. Teachers should check the suitability of all recommended resources for their specific group.

- Sample Scope and Sequence
- Community of Practice Information

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