L-Università ta' Malta

MATSEC
Examinations Board

School-based Assessment Exemplars

SEC 33 Design & Technology

2025

Table of Contents

School-Based Assessment Exemplars

Exemplar 1: Portfolio

Portfolio	
	Defining a Portfolio In industry a Portfolio is used as a showcase of one's best work or as a 'job-bag' which carries the ongoing development of a project or activity. Some D&T teachers might relate the term Portfolio to the Design folio, which typically is the full documentation of a complete design and make project. In this case a Portfolio refers to a learning mode that gives flexibility in learning design and technology through an open selection of mini projects, which individually do not cover a full design process, but focus on different parts of it and use different approaches. The Portfolio mode provides students ample opportunities to learn and evidence aspects of exploration, designing, making, evaluating and also presenting their work, in five different modalities to choose from. **Aim of a portfolio** Research on assessment in D&T suggests that setting of *"an inflexible portfolio assessment structure is detrimental to student learning"* (Welch and Barlex, 2004) and they recommend that offering different approaches to both the design process and the fulfilling of a portfolio is crucial. Barlex and Steeg (2013) suggest that teaching activities during D&T lessons may involve: ● making but not designing with an emphasis on the range of tools, materials and equipment used; ● designing but not making with an emphasis on the use of a new or emergent technology; ● designing and making of an item with an emphasis on design decisions taken with respect to an open task; ● indicating the various intended and/or unintended impacts when a particular technology or artefact is used. Moreover, one may describe a portfolio as a constructivist ongoing assessment tool *"Portfolios are one authentic assessment tool requiring the active construction of meaning rather than the passive regurgitation of isolated facts"* (Barlex and Steeg, 2004). **The Portfolio as learning tool** Design and Technology is a subject that requires learners to develop ability for innovative and creative thought through the planning and development of design activities as well as to acquire a wide range of technological knowledge, as well as the execution of numerous practical skills. The use of portfolios is being recommended as an authentic and formative assessment strategy where the assessment is used to aid and support the learning process (Chetcuti & Grima, 2001). The portfolio, when interpreted as a learning tool, guides teaching and learning in focusing on the learning outcomes in a variety of applied approaches. Design skills, which may be transferrable as lifelong skills, are explored using a range of design process methodologies, while technological knowledge, skills and attitudes are presented as the means not the end. The portfolio assesses the learners' ability to engage with a spectrum of D&T learning opportunities. **Content reference in Portfolio** The Design and Technology syllabus learning outcomes are specifically non-prescriptive and do not define the coverage of specific tools, equipment, components, materials or techniques and processes. However, the content range tables, provided within this document, describe the breadth of such learning content in detail. The portfolio mini projects should consider this range

as its knowledge library, while at the same time use the coursework as a means to present emergent knowledge, from within such range.

Implementing the Portfolio Assignment

The Portfolio should include the following three components, which should be compiled in one general portfolio document:

- Portfolio Setup and Presentation, and Evaluation;
- Mini Project 1;
- Mini Project 2;

The Portfolio Assignment can be implemented in class, as explained in the following steps:

Step 1: Student - Prepares a general portfolio document (e.g. booklet, scrapbook, file, digital document, etc.) and enters the introductory information (name, surname, class, titles of selected Mini Projects, etc) following guidelines provided by the teacher.

Step 2: Teacher - Introduces Mini Project 1 (chosen from Mini Projects A to E) and provides the relevant project information (e.g. title, situation, restrictions, etc.).

Step 3: Student - Enters the information relevant to the chosen Mini Project as a section of the Portfolio and carry out the mini project as per guidelines below (See section Portfolio Content Guidelines below).

Step 4: Student - Inserts the required work related to Mini Project 1 in the respective Portfolio section in an organised and structured way.

Step 5: Teacher - Introduces Mini Project 2 (chosen from Mini Projects A to E) and provides the relevant project information (e.g. title, situation, restrictions, etc.).

Step 6: Student – Repeats Steps 3 and 4 for Mini Project 2.

Step 7: Student - The Portfolio is completed, including an evaluation of the overall portfolio learning experience referring to both Mini Projects presented and submitted to the teacher.

Presented Portfolio documents

Students are expected to compile a physical portfolio document as an overall deliverable for this mode. However, some assessment tasks require the presentation of non-written material, physical artefacts, digital presentations, audio visual resources etc. A combination of such media is acceptable as long as all material is recorded in an official way (e.g. stored media, cloud storage) up to moderation point.

Note: The implementation of all Mini Projects requires the access to a suitably managed school Design and Technology workshop, equipped with a range of tools, machines and equipment, design exploration areas, CAD-CAM and ICT equipment, all installed in accordance with all required Health and Safety provisions applicable. Teachers are recommended to implement an approach of mixed-activity-learning in order to address tasks efficiently and safely.

The Mini Projects

For the Portfolio assignment, the students will present TWO different Mini Projects, which are selected from the following FIVE choices and set by the teacher accordingly. A Mini Project should take from 6 to 8 lessons to complete.

Mini Project A – Design-and-pitch

The aim of this Mini Project is to introduce design idea research and exploration, prepare design concepts that highlight focused design ideas and introduce entrepreneurial skills required to propose concepts effectively. Students are given a design problem (e.g. Solving issues with tangled cables in any consumer products), which they need to explore and then come up with relevant design ideas. One design idea is then chosen and students will prepare and deliver a presentation to an audience (2-3 minutes) where they communicate the research carried out and pitch their proposal in an entrepreneurial way.

Mini Project B – Emergent Digital Prototyping

The aim of this Mini Project is to expose students to the wide range of emergent technologies changing the way people work and live. The project involves designing and prototyping a product (e.g. a digitally fabricated water wastage reduction device, personalised item that reduces need for single use plastics, etc.) using CAD-CAM techniques and equipment and relating such product to real life use, while introducing critical thinking in respect to the adoption of digital fabrication in the workflow. Students apply digital fabrication, itself an emergent technology, to design and plan a product they develop in response to the given design situation and finally evaluate the implications of their work process and possible further development.

Mini Project C – Creative Sustainability

The aim of this Mini Project is to explore sustainable design approaches which place emphasis on adopting strategies like Recycle, Reduce, Reuse (3Rs) in developing a required design solution. (Further discussion about the 6Rs is recommended.) Students are given a design situation (e.g. need for degradable or sustainable gardening equipment like pots, benches, shelves, etc.) which following exploration, and possibly discussion, they will design and make a model solution using upcycled, recycled or reused materials, parts or components. This will extend the life cycle and creatively give a new function to otherwise wasted materials. Students will evaluate the work produced and the sustainable aspect brought forward.

Mini Project D: Reverse Engineering

The aim of this Mini Project is to apply the Reverse Engineering approach within the design process and through deconstructing (breaking down into smaller parts) an existing product, students learn how to explore its features. Students extract design information through the analysis of the product's basic system, make modifications at systems level and ultimately derive the scope of the new product by developing a design brief and a modified proposed design.

Examples of an existing product may include a low-tech consumer product (torch), a simple tool (pistol grip clamp), interesting toy (automata), sport and hobby equipment (bicycle pump, fishing rod), etc. When the product given to the students includes electronics and/or moving parts, it is highly recommended that only low voltage and/or low rpm (revolutions per minute) products be used ensuring that all H&S provisions are maintained.

Mini Project E: Making it Right

The aim of this Mini Project is to make students more familiar with workshop manufacturing and testing practices and processes and to learn that in real life, manufacturing requires 'making it right!' Throughout this Mini Project the students are made aware of the workshop process flow in manufacturing quality parts and products that are suitably tested to satisfy required criteria. Each student will interpret a complete job sheet, which includes complete design information of a product or part, and in turn prepare and manufacture the product/part similar to what happens in the manufacturing industry. Students will perform a relevant test on the product/part, record and interpret the results.

It is suggested that for this Mini Project the teacher presents the design information of a variety of products/parts for the same group, instead of just one, to use resources and equipment more efficiently and effectively. Students of a group may be working on a different product/part. Examples of products suitable for this Mini Project may include workshop marking instruments (e.g. beam compass), simple scale model vehicles (e.g. wind/electrically propelled cars/boats), decorative items intended for large scale of production (festive textile decorations, flashing LED light), etc. Examples of parts may include a light depending sensor circuit module as part of a simple alarm, the internally divided drawer of a jewel case, a tool guard, a textile sleeve, cover or pocket for a specific tool/instrument, etc. The teacher presents a range of product tests (at least 2) and the students apply the relevant test to their particular produced product or part, thus product testing becomes more specific to the processes involved.

Comparison of the 5 Mini Projects

The following table presents a comparison between the 5 Mini Projects which can be implemented as part of the Portfolio assignment. This comparison can help the teacher choose the most appropriate Mini Project which best complements the learning experience of the students. The table indicates to which extent each of the Broad design process stages feature in each Mini Project and the extent of focus on the presentation skills expected.

Mini Project		**Explore**	**Design**	**Make**	**Evaluate**	**Present**
A	Design-and-pitch	●●●	●●	●	●	●●●
B	Emergent Digital Prototyping	●●	●●●	●●	●●	●
C	Creative Sustainability	●●	●●●	●●●	●	●
D	Reverse Engineering	●●●	●●●	●	●●	●
E	Making it Right	●	●	●●●	●●●	●●

Portfolio content guidelines

Portfolio	
Setup and Presentation	For the Portfolio setup, the student is expected to: - provide the general student information in an individual portfolio document (e.g. booklet, scrapbook, file, digital document); - organize the document in such a way that the two selected mini-projects can be documented in an organized and structured way; - organize the collated material from the two selected mini projects as per guidelines outlined for each Mini Project.
Evaluation	For this section, the student is expected to: - write an evaluation of the overall learning experience by referring to the presented portfolio entries of the two selected Mini Projects.
Mini Projects	
TWO different options selected from Mini Projects A to E below. *Each Mini Project is selected and set by the teacher as per respective guidelines below.*	
Mini Project A – Design-and-pitch	
Design Exploration	This section should include: - a visual presentation of information highlighting the different aspects of a presented design problem (e.g. annotated mood board, collage, chart, presentation slides) which communicates effectively the main parts and stakeholders of the explored context.
Concept modelling and communication	For this section the student is expected to: - design a number (at least 3) of relevant, imaginative and realistic design concepts presented graphically as a basic system overview (with minimal manufacturing details); - choose one design concept and develop it as a design idea (design concept may be chosen following focus group feedback session involving teacher and/or peers); - present the design idea, taking care to: ○ apply appropriately good communication skills producing graphical representations that are clear; ○ include annotations, design dimensions and materials/components; ○ apply 2D and 3D drawing techniques.
Pitch / presentation	For this section the student is expected to: - prepare a concise presentation which includes the material developed in the previous sections (e.g. Powerpoint, chart, etc.); - deliver the presentation to an audience (e.g. the class), communicating the insights and pitching the proposed design idea in an entrepreneurial way.

Mini Project B: Emergent Digital Prototyping	
Exploring an Emergent Technology	This section should include: - a design brief which: o is developed through an analysis of a given design situation and following a discussion about emergent technology that may be applicable in solving the presented design problem in a real-life situation; o highlights the main need of the situation; identifies main stakeholders; is marketable to an identified target market; o includes the potential to apply an emergent technology discussed.
CNC/CAD CAM prototyping	For this section, the student is expected to: - develop a solution that responds to the design brief following a discussion (e.g. focus groups, teacher, class, etc) and design a digital model of the solution through the use of CAD-CAM; - communicate the steps required to manufacture the prototype using any CAD-CAM or CNC equipment (the actual manufacturing is not required).
Evaluating digital prototyping	This section should include: - an evaluation on the use of CAD-CAM processes within the proposed design, eliciting advantages, disadvantages; - reference to a relevant possible further application of emergent technology for the future development/manufacturing of such a product.
Mini Project C: Creative Sustainability	
Sustainable design brief	For this section, the student is expected to: - communicate an analysis of a given design situation applicable in solving the presented design problem (analysis can be done through a discussion about sustainability); - develop a design brief which highlights the main need of the situation; is marketable to an identified target market; identifies main stakeholders and refers to how the application of the 3Rs may benefit them.
Designing and modelling using ready made products	For this section, the student is expected to: - communicate an original design idea which responds to the proposed design brief including the application of sustainable strategies (3Rs); - model a sustainable design solution which: o includes upcycled, reused or ready-made components; o is functional or usable. The student can work on both items above in any preferred order since modelling may lead to better sketching of ideas and vice-versa.
Evaluating sustainable design	This section should include: - an evaluation of the model produced and the processes adopted, with respect to the needs identified in the design brief; - reference to one aspect related to sustainability with regard to implementing such a product in the market.

Mini Project D: Reverse Engineering	
Product Analysis	For this section, the student is expected to: - study carefully the given product in terms of the following design information aspects: o functions and features; o parts and components; o materials and textures; o aesthetic appearance; o market appeal; o manufacturing processes required. - communicate a detailed product analysis of the given product: o which makes reference to the aspects of design information mentioned above; o in the form of annotated drawing/s, diagram/s and/or image/s of the given product.
Design modification	For this section, the student is expected to: - draw a system diagram (block diagram) representing the analysed product, which includes: o INPUTS, OUTPUTS, PROCESS and any feedback loops if applicable; o an indication of the driver or power source as a separate block; o neatly drawn blocks, arrows, and any connectors or feedback loops, where applicable (digital drawing aids may also be used). - draw a modified system diagram to show a functional modification to the product including a description that explains the scope of the modification.
System Engineering	For this section, the student is expected to: - develop a design brief which: o guides the design and make of the modified product as per modified system diagram; o highlights the main needs related to the modified product; identifies main stakeholders; is marketable to an identified target market. - present a design idea, in the form of conceptual sketch/es, which: o addresses the design brief; o shows the modified product features including relevant design annotations.

Mini Project E: Making it Right	
Interpreting the job sheet	For this section, the student is expected to: - study carefully the given design brief, specifications and working drawings of a finished product/part and information about the required equipment to manufacture the product/part; - compile an organized Cutting and Component list required to manufacture the product/part; - list the PPE required.
Manufacturing	For this section, the student is expected to: - carry out the relevant manufacturing process/es to manufacture the product/part in a school D&T workshop; - follow all workshop rules and H&S recommendations (equipment and PPE); - work under supervision of qualified school personnel.
Checking production	For this section, the student is expected to: - study carefully a range of suggested product/part tests; - perform a relevant test; - appropriate communication of test results (e.g. table of results, photographs, infographics); - a short interpretation of the results.

References

Barlex and Steeg, 2013 retreived in July 2021 from: https://dandtfordandt.wordpress.com/working-papers/assessment-in-dt/refocussing-assessment-design-technology/five-key-questions/

Chetcuti, D., & Grima, G. (2001). *Portfolio assessment*. Floriana: Ministry of Education.

Chetcuti, D., & Grima, G. (2003). *Current assessment practices in schools in Malta and Gozo - a research project* University of Malta. Faculty of Education.

Welch, Malcolm; Barlex, David (2004): Portfolios in design and technology education: investigating differing views. Loughborough University. Online resource. https://hdl.handle.net/2134/2864

Welch, Malcolm & Barlex, David & Taylor, Krista. (2005). I don't enjoy making the folder: secondary students' views of portfolios in technology education.

Exemplar 2: Product Design Project

Product Design Project	
	Defining a Product Design Project Focusing on a specific classroom-workshop setting, initially, a technological situation or problem is set by the teacher, comprising a degree of openness relevant to the students' familiarity within the field in question. From there onwards, the D&T design process manifests itself via a number of design aspects which take place across interconnected perceptive phases that the designer goes through as the product design project unfolds. The student iteratively explores, designs, makes and evaluates a series of generated ideas with respect to design specifications which stress the design parameters of the situation at hand. All progress achieved at various stages is documented and presented via various means of expression within a formal design folio. **Aim of a Product Design Project** The 'learning by doing' feature within D&T is primarily achieved via design-and-make tasks, through which students' progress along a design process to accomplish. D&T induces design from pupils in the form of a creative process; a perpetual and iterative cycle across numerous aspects through which the attributes of the designer and the user alike eventually meet halfway towards a final product rendition. The design process develops lateral thinking capabilities within students as they explore, design, make and evaluate ideas with respect to specific technological needs that a person may come across in real life. Hence, through a product design project, D&T pupils learn to design solutions to technological problems, applying knowledge specific to the subject as well as knowledge from other areas to search for various ideal solutions. By exploring, designing, making and evaluating ideas for chosen products, students discover the parameters of specific technological areas and eventually infuse their gathered theoretical and practical knowhow as they progress from conception to completion. **The Product Design Project as a learning tool** As the product design project progresses, the central goal of the teacher should be the student's cognitive shift from structured tasks to increasingly complex open-ended ones. This action effectively emancipates the student from a knowledgebase comfort zone in order to tackle new challenges and gather new skills, and ultimately moves him or her from a familiar to an unfamiliar design context. This developmental route is very much in line with the psychological notion presented via Vygotsky's Zone of Proximal Development, wherein a teacher gradually removes the training wheels off the student, this paralleling reduction in teacher intervention, so that true student empowerment can take-off (*Vygotsky, L. S. (1978). Mind and society: The development of higher psychological processes. Cambridge, MA: Harvard University Press*). Hence, as can be deduced, the purpose of the product design project is not the realisation of the final product per se, but rather the unravelling of technological concepts, procedures and principles as the student, or designer, encounters new territory throughout his journey within design. Ratifying this statement, Singh (1999) shows that whilst a student is designing and going through a design process, the student's mind is converted into a virtual design studio in which information and ideas are infused together to formulate viable solutions (*Singh, A. (1999). The potential of mental imaging in the architectural design process, IDATER 1999 Conference. Loughborough: Loughborough University, pp. 230-231*). Thus, the product design project in itself accentuates initiative through idea generation and technological exploration.

Content reference in Product Design Project

The Exploration Stage
Throughout this stage, students should gain an understanding of the problem, seek information that will aid them in solving the problem and determine what techniques may be used in solving the problem.

- Design Brief
  The design brief aspect is expressed as a short statement of the problem to be solved, recognising the need, the purpose and the condition under which a situation is subjected to, without describing the final outcome. Although at this stage the design brief in itself must be a product of individual and personal thought, group verbalisation could take place at classroom-workshop level so as to trigger further student interest in the situation.
- Research
  Within the design aspect of research, one identifies the knowledge and understanding of what is yet unattained and starts discovering how he or she can go about gaining it. Concepts, procedures and principles relevant to the situation in question are gathered, sorted and investigated thoroughly. This aspect, like all others, may be reverted back to as the design and make task unfolds and the experience per se enriched through newly gained knowledge.

The Designing Stage
Throughout this stage, students should devise numerous specifications that their design will recurrently adhere to and eventually generate a series of ideas based on said parameters.

- Design Specifications
  In itself, the design brief should be enough of an aid for students to be aware of the design implications and constraints involved within their design process along the road to product realisation. Thereby, design specifications should represent an analysis of the design brief; they ought to describe what the product needs to satisfy in accordance with the design brief, expressed in the form of an exhaustive list that includes a weighing in requirement priority. Here, the teacher must attempt to encourage the students' reasoning within specific factors that directly concern their design thinking, prompting them to ask further questions with regards to the situation at hand. Key factors may include the following:
  - Context: Where, when and how the product will be used;
  - Aesthetics: Size, shape, proportion, balance and colour;
  - Performance: Function, efficiency and ergonomics;
  - Production: Cost and production timescale;
  - Maintenance: Quality, safety and reliability.
- Generation of Ideas
  Generation of ideas is the design aspect in which preliminary ideas are expressed via sketching and notes; these may also be expressed in fragmented parts if ideas eventually tend to become intricate in nature. Sketching has always been regarded as a key way of representing and recording decisions as it serves as a display for the designer to react to (*Goldschmidt, G. (1992). 'The dialectics of sketching'. In Creativity Research Journal, Vol. 4, No. 2, pp. 123-143*).

The Making Stage

Throughout this stage, design concerns should revolve around technological exploration, initial and final expression of design proposals, establishment of a plan of work for the realisation aspect and eventually, the manifestation of said realisation aspect itself.

- Development
  Development encompasses the expression of design ideas with respect to the specifications under which the product will function as well as with respect to all the processes required from conception to realisation, via sketches, notes and models. Working drawings are then drawn up in accordance to said design development, containing all the relevant information required to make the product.
- Planning
  Planning is the identification of the main processes required to produce the product and the consequent establishment of a procedural timetable vis-à-vis the execution of said processes.
- Realisation
  Realisation of the product itself is not, formally, part of the design process, but rather the fruit of its labour; the final rendition of the combined investigative, developmental and reflective phases and their subsequent aspects of design.

The Evaluation Phase

Throughout this stage, adequate tests are carried out so that strengths and weaknesses in design are sought out by the designer as well as by potential product users; this eventually leads to the formulation of future modifications within the product design and thus also within the realisation aspect itself.

- Testing
  Testing involves the identification of the aspects and standards against which the product and its design process will hold up to scrutiny, along with result tabulation and reflection upon safety measures taken. Future improvements closely follow and intertwine with this design aspect as it revolves around the identification and, if possible, the implementation of the features which need to be modified after being scrutinised thoroughly.
- Evaluation
  Evaluation is a crucially ongoing aspect of design as it is constantly referred back to as the designer moves from conception to realisation. It involves feedback with respect to the strengths and weaknesses of the design process aspects and the final product itself via self-reflection as well as views of others, with special consideration towards sustainability, emergent technology and improvements.

Implementing the Product Design Project Assignment

The Product Design Project should include the following four steps/sections, developed as per guidelines below and finally submitted as a compiled design folio (e.g. booklet, scrapbook, file, digital document, etc.) organised as per the following guidelines:

Step 1: Explore; Step 2: Design; Step 3: Make; Step 4: Evaluate.

The Product Design Project Assignment can be implemented in class, as explained in the following steps (T - teacher, S - student):

Step 1 - Explore:

T Sets and introduces a Situation for the Product Design Project and provides the relevant project information (including the requirements and expectations of the project, restrictions and main stakeholders).

T Presents an initial Design Brief. This can be further explored and developed through a class discussion.

S Studies carefully the provided information and presents it in a visually organised way under the section *Explore*, highlighting the explored aspects of the problem concisely, and the initial design brief.

Step 2 - Design:

S Designs a range of relevant design Ideas appropriately presented.

S Writes the key Specifications, derived from the information provided and the ideas designed; develops further specifications.

T Provides technical feedback on the ideas proposed and specifications derived, emphasising on the importance of ideas being realistic and feasible.

S Produces a comparison table that communicates the selection of a chosen Idea.

S Writes a developed Design Brief that reflects any amendments required.

Step 3 - Make:

T Guides students to safely use workshop equipment and schedule use and distribution of materials required.

S Plans the individual parts and components of the proposed solution, including working sketches and a work plan.

S Starts and performs the manufacturing processes planned following all H&S requirements, following the set work plan in order to produce a working solution.

Step 4 - Evaluate:

S Writes a product evaluation and a self-evaluation.

Step 5 - Present:

S Compiles a design Folio which documents the process as described in the Product design Project and submits it for assessment to the teacher.

Note: During the design process, some work may be attempted more than once or modified in a second attempt. This is called design Iteration and may be beneficial to document as well. In such cases these are notified as 'Iterations'.

Section 1: Explore	
Exploring	The student is expected to study and research thoroughly a provided design situation including details about a problem, some restrictions and stakeholders and a provided initial design brief. For this section, the student is expected to: - outline the Project research by communicating the information provided, project stakeholders and other implicit needs and opportunities in good detail in a visually organised way (such as: web diagrams, mind maps, infographic, etc.); - highlight the main needs within the problem presented.
Section 2: Design	
Designing	For this section, the student is expected to: - design a number (at least 3) of relevant, imaginative and creative design ideas, describing features proposed, usability and respective design information that respond to the design brief; - to present these design ideas, taking care to: o include annotations, design dimensions, materials and textures; o apply 2D and 3D drawing techniques to communicate a proposed manufactured product (freehand and digital). o outline project specifications and any further specifications derived from the design ideas (e.g. restrictions, timeframe, safety, facts, target users, particular functions, quality).
Chosen Idea	This section should include: - a comparison table which communicates the way the different design ideas satisfy the project specifications leading to the selection of a chosen idea. - an outline of any required amendments to the given design brief reflecting the chosen idea.
Section 3: Make	
Planning	This section should include: - a range of working sketches communicating the chosen idea and its parts which include: o design information (dimensions, materials and/or components used, any required calculations, finishes). - a sequential work plan for the proposed product presented in a graphical manner (e.g. Gannt chart, table, etc) taking care of: o Health and Safety and PPE required; o resources; o time allocated.
Making	For this section the student is expected to: - perform manufacturing processes (e.g. marking, cutting, constructing, soldering, etc.) and assemble an initial prototype of good quality with suitable finishing processes applied and that responds to the set parameters in terms of form and/or function.
Section 4: Evaluate	
Evaluating	This section should include: - an evaluation of the project implementation referring to the solution produced including feedback gathered from others other critical considerations; - a self-evaluation of the project highlighting what was learnt and proposes possible modifications and developments.

Exemplar 3: Iterative Design Proposal

Iterative Design Proposal	
	Defining an Iterative Design Proposal The Iterative Design Proposal assignment is an educational coursework that builds confidence and frames the problem that a student shall further work on and potentially solve. Students may use the work developed in this assignment mode, i.e. the Iterative Project Proposal, as the basis for continuation of other assignment modes, thus developing to a holistic ***Iterative Design Process*** from the assignment modes available. Through the development of an Iterative Design Proposal, a student has the opportunity to fine tune ideas and effectively validate them with the feedback received. The Iterative Design Proposal as an assignment guides students to frame their ideas, focus their attention on a feasible problem and also not be afraid to take risks. According to Westhead & Wright, M. 2016, entrepreneurs are people with practical application who contribute to solving particular problems in the environment with proactivity, innovativeness, capacity to assume the risk and to manage changes. **Aim of an Iterative Design Proposal** The Iterative Design Proposal as a learning tool provides ample opportunities for Education for Entrepreneurship, Creativity and Innovation, one of the cross curricular themes identified by the Learning Outcomes Framework, Malta. This focuses on the aspect that communicating ideas to others builds towards an entrepreneurial mindset. Entrepreneurship education is essential not only to shape the mindsets of young designers to empower them (Rosen, 2015). The aim of this assignment is twofold, whereas students are guided to embark on an entrepreneurial process and also construct the foundation for a holistic Iterative design process, accomplished through the other assignments provided. **Content reference in an Iterative Design Proposal** The key content related to this assignment is found in Design Aspect Learning outcomes, particularly within the area of idea exploration. Content range tables provide detailed terms in relation to this area, with most relevance with regards to developing a Design Brief, carrying out research, using research methods and learning about project stakeholders. **Implementing the Iterative Design Proposal Assignment** The Iterative Design Proposal should include the following three steps/sections, developed as per guidelines below and finally submitted as a compiled design folio (e.g. booklet, scrapbook, file, digital document, etc.) organised as per the following guidelines: Step 1: Explore; Step 2: Designing a concept; Step 3: Design Proposal. The Iterative Design Proposal Assignment can be implemented in class, as explained in the following steps (T - teacher, S - student):

Step 1 - Explore:

T Introduces the theme issued by MATSEC which includes a selection of 3 Design Situations. These thematic situations shall be all discussed in class leading to different students selecting ONE particular theme individually after having considered the potential realisation of all the three situations. Each situation presented to students provides the relevant project information including a broad reference to:

- the requirements and expectations of the project;
- restrictions;
- the main stakeholders;
- the problem that needs to be tackled.

S After having studied the theme well and considered carefully the selection of situations offered, the student shall commit to ONE Design Situation.

S Start research work on the selected Design Situation, aimed at framing a unique problem and related opportunities, presenting such information in the form of a visual research outline, highlighting needs, opportunities and stakeholders.

S Present detailed research about the specific problem area being tackled in response to the selected Design situation and summarises this information in an organised manner.

Step 2 - Designing a Concept:

T Guides students in being entrepreneurial and imaginative in their original project concept, while keeping in mind a realistic realisation.

S Writes the initial project specifications.

S Writes the unique, initial Design Brief for the project.

S Designs and presents design ideas relevant to the identified information.

S Presents information that compares and justifies the selection of the most promising idea.

Step 3 - Design Proposal:

T Shows students' examples of product proposal pitches, guiding them to present their own project proposal in the form of an entrepreneurial short proposal presentation.

S Prepares and delivers a short project proposal presentation highlighting the central idea being presented.

S Submits the different parts developed and prepared within all this assignment and submits it for assessment to the teacher.

Note: It is recommended that the teacher facilitates the collection of critical feedback by each student on their respective concepts.

Section 1: Explore	
Investigating the Context	Upon choosing ONE Design Situation, the student is expected to: - Outline the Project research areas by communicating the information provided and other implicit needs and opportunities in good detail in a visually organised way (such as: web diagrams, mind maps, infographic, etc.). - Mention the possible relevant Project stakeholders and make reference to their needs and/or contribution to the project *(These may be included in the visual/analysis presented for the previous point or listed separately.)*
Gaining Research Insight	This section should include: - An organised collection of broad research data in relation to the identified research areas providing insight to the Project. o Research presented: ▪ should be relevant, of adequate detail and well-referenced; ▪ may be self-sought through adequate research methods o Research should include: ▪ market research (e.g. existing products, alternative solutions, available technology); ▪ possible solution components (e.g. systems, materials or components); ▪ a list of the main needs identified. - A concise summary of the relevant information presented in a visually organised way (e.g. annotated mood board, collage, chart, presentation slides) which communicates effectively the main insights.
Section 2: Designing a Concept	
Developing the Design Brief	This section should include: - separate (3 – 5) design specifications which describe in appropriate detail the design requirements (e.g. Restrictions, budget, timeframe, facts, target users, sustainability, specific safety concerns, etc.) reflecting information given and/or found in relation to the given situation. - a marketable initial Design Brief that: o communicates in writing the aims and specifications of the project; o makes reference to key stakeholders; o highlights possible market opportunities; o mentions the essential needs identified within the problem; o hints to a proposed solution.

Generating Design ideas	For this section, the student is expected to: - design a number (at least 3) of relevant, imaginative and creative design ideas, describing features proposed, usability and respective design information that respond to the design brief. - to present these design ideas, taking care to: o apply appropriately good communication skills producing graphical representations that are clear and well presented; o include annotations, design dimensions, materials and textures; o apply 2D and 3D drawing techniques to communicate a proposed manufactured product (freehand and digital). - draw a comparison table which communicates the way the different design ideas satisfy the project specifications leading to the selection of a chosen idea.
Section 3: Design Proposal	
Presentation	For this section, the student is expected to: - deliver a Project Proposal: o in the form of a presentation to an audience (teacher and classmates) which may include visual aids (PowerPoint presentation, charts, audio-visual resources); o which presents the argument for the chosen idea; o that includes a summary of all the work related to the research and design carried out as per Sections 1 and 2; o which may include some projections for the development of this idea and/or gather feedback. - show entrepreneurial skills (a sense of ownership, communication, leadership, etc).

References:

Westhead, P. & Wright, M. (2016). Introduction. In The Habitual Entrepreneur. Abingdon, Oxon: Routledge. 1-11.

Rosen. A. (2015) The Skills You Really Need to Get a Job. Cited from: https://www.tandfonline.com/ (*Entrepreneurship and Innovation Design in Education. An educational experience to train the new entrepreneurial designers, 2019*)

Learning Outcomes Framework, 2016 Ministry for Education and Employment, Malta. https://www.schoolslearningoutcomes.edu.mt/en/category/cross-curricular-themes

Iterative Design Proposal Exemplar	Expanding the Situation Grid- Discussion Referring to Situation 1 – in the specimen Themes and situations provided in this syllabus, the candidate will interpret the chosen situation, understand it further and start exploring the problem further.

All provided situations are discussed in detail, explaining what context is relevant and what still needs to be defined.

The Environment where a situation takes place in this case is only partially defined. The candidate has a wide range of options where to delve deeper.

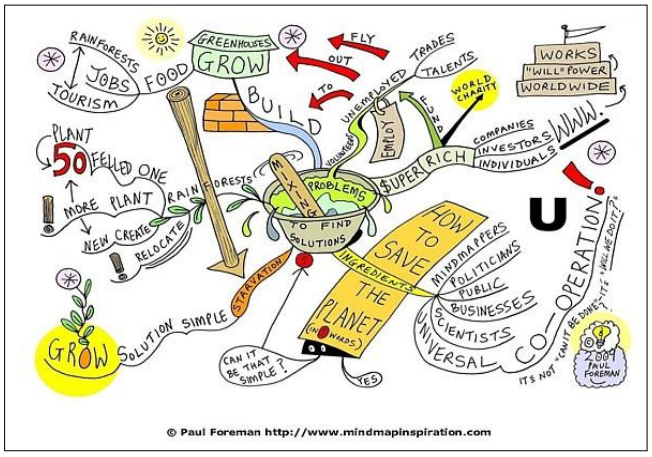
	Context	Environment	Need	User
Level of given specification	●○○	●○○	●●○	●○○
Information	enjoying an outdoor lifestyle	outdoor	access simple tasks independently	people with physical issues

The identified needs are like set specifications, which need to be investigated to find new opportunities.

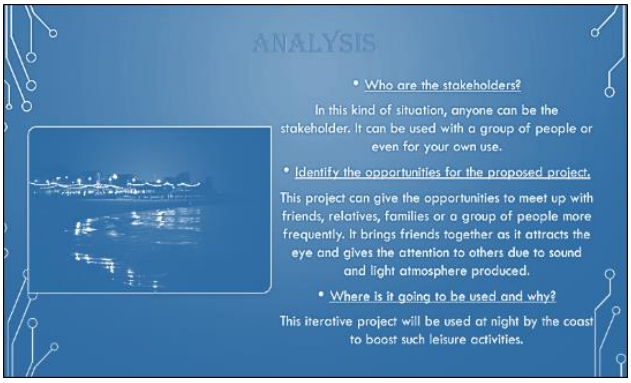
The user may be broadly defined too, as more stakeholders or potential customers are then identified.

Investigating the context

Project research: Mind map to investigate Sustainable Living

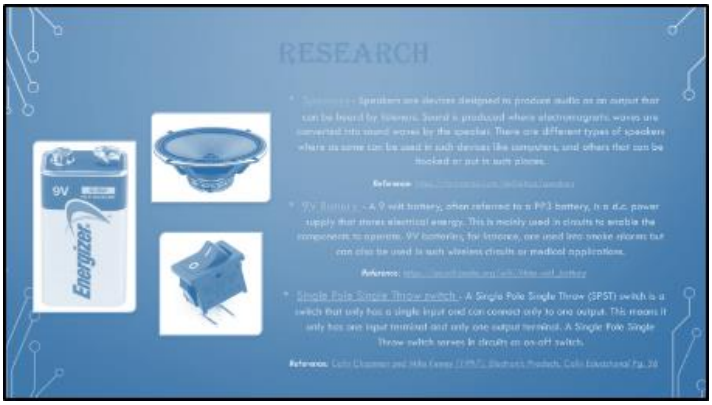


Project Stakeholders: Investigating a multimedia lamp device

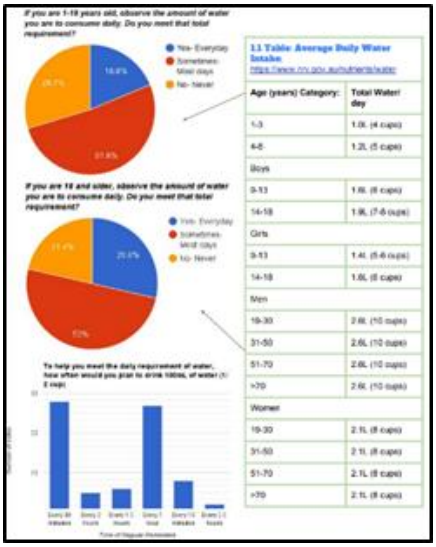


Gaining Research Insight

Research on relevant electronic devices and components

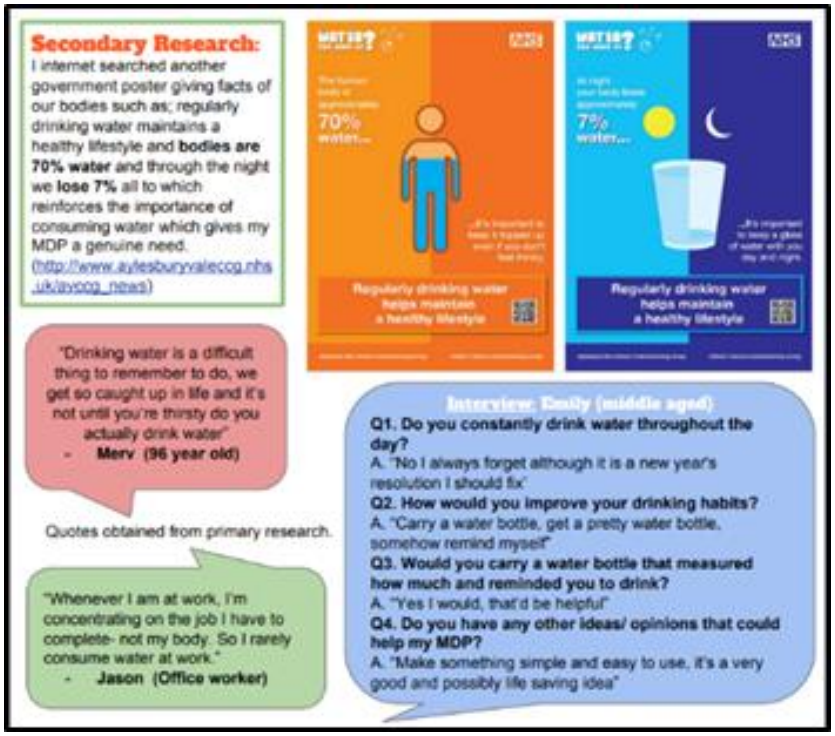


Market research data / insights



www.maas.museum

https://www.hausmanmarketingletter.com



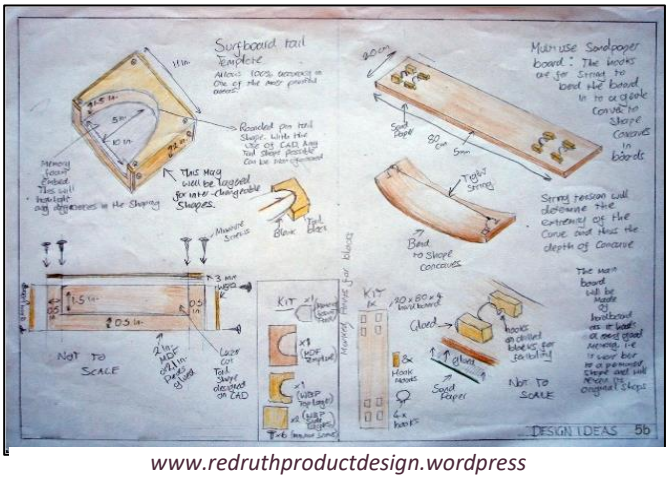
www.maas.museum

Developing a Design Brief

Design specifications and design brief slides

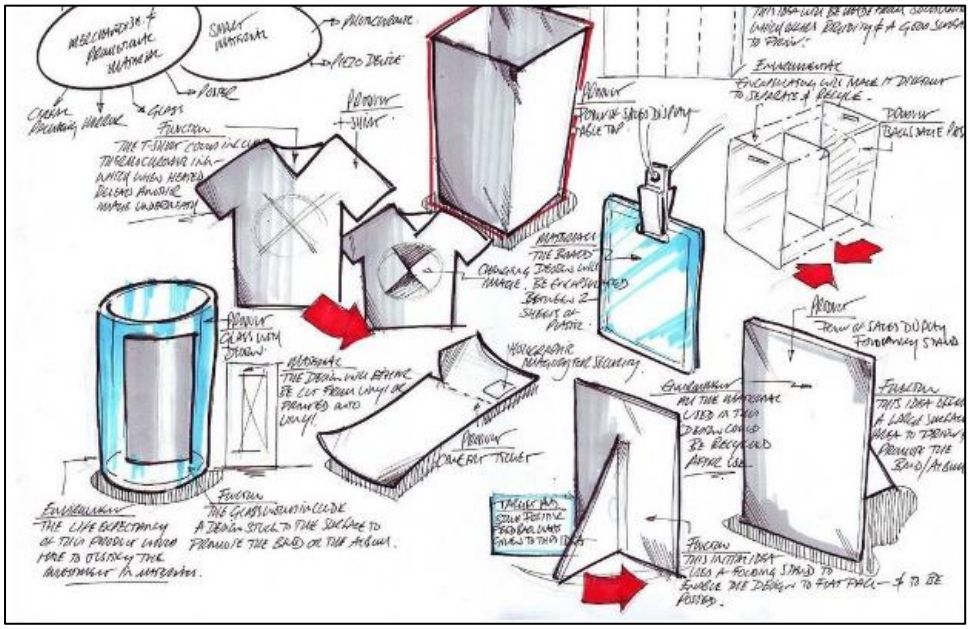
Generating Design Ideas

Conceptual ideas, idea iterations generated through sketches and annotations; producing simple models to develop ideas.



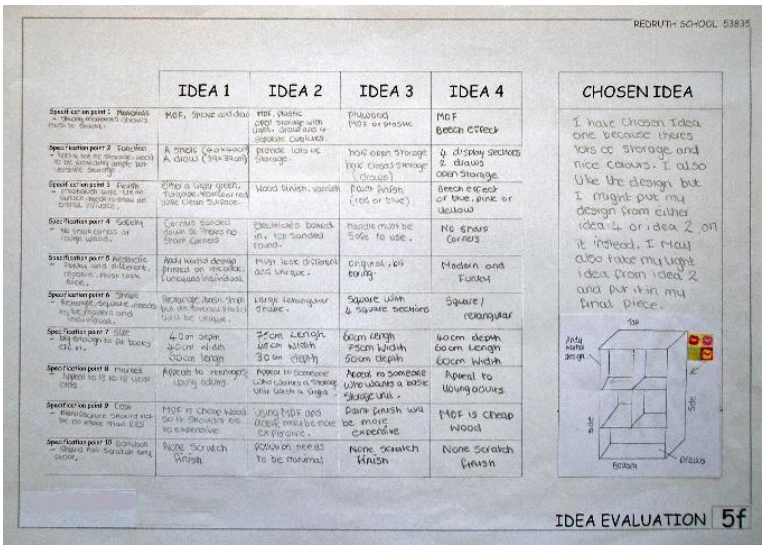
www.redruthproductdesign.wordpress

www.redruthproductdesign.wordpress



www.redruthproductdesign.wordpress

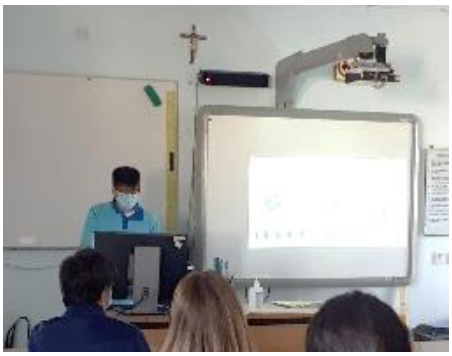
The chosen idea – identified following evaluation of each idea.



www.redruthproductdesign.wordpress

Presentation

Examples of typical class presentations of project proposals.



Exemplar 4: Iterative Development and Making

Iterative Development and Making	
	Defining Iterative Development and Making The Iterative Development and Making assignment is an educational coursework that is intended to assess the realisation of a design solution. This assignment expects a problem to be already defined and builds on a proposed design idea through the development of detailed design, project plans and ultimately the manufacturing of the project idea into a relevant solution. Students may use the design work explored in the Iterative Design Proposal to implement this assignment. Students may also build further on the work done in this assignment (Assignment 4) to finalise and evaluate a complete design solution by implementing Assignment 5 and thus cover the widest range of subject knowledge, learning outcomes and skills, while experiencing a holistic design process cycle. This assignment carries extensive assessment of the practical aspect of the holistic design process and the implementation of a fully proposed idea. This is expected to be done following a design methodology of defining task components, parts, dimensions materials and the manufacturing processes required to plan and make the latter. Good workshop practices and health and safety considerations are not only essential but form an integral part of this assessment component. **Aim of Iterative Development and Making** The Iterative Development and Making as a learning tool puts the skills of applying theory into technological practice at the forefront. Making something addresses all the three learning domains (Sousa, 2016) starting from the psychomotor domain of learning, but drastically involving the affective domain as a task becomes owned by its maker. Nevertheless, when applying technological theory into practice the student develops higher order cognitive skills. The importance of the making aspect within such an assignment is highlighted by Banks and Owen-Jackson (2007), who claim that: *"making is important to design & technology, that through the making process pupils learn technical knowledge…, characteristics of materials…, planning, independent learning, problem solving. Making can also contribute to pupils' emotional development by fostering decision making, motivation and self-esteem."* **Content reference in Iterative Development and Making** Communicating a developed design solution requires a student to be graphically and technologically literate. This assignment refers extensively to Graphic and communication skills found in the learning outcomes 11 and 12 and further explained in the content range tables. The technical range of content applicable to 'Making' a solution is indeed very wide but is limited to a range provided in the latter tables to guide students and educators manage the activity. Thus, solutions are mainly focusing on the mechanical, electronic, including programmable microcontrollers and typically prototyped through physical artefacts. The use of digital manufacturing processes, CNC and other prototyping equipment (E.g.: 3D printers) is included like any other processes involved.

Implementing the Iterative Development and Making Assignment

The Iterative Development and Making assignment should include two steps/sections, **Design Development** and **Prototyping**, developed as per guidelines below. This Assignment can be implemented in class, as explained in the following steps (T - teacher, S - student):

Step 1 - Design Development

T Ensures that students have an already defined design project context, which includes detailed specifications, a chosen idea and a design brief (e.g. The Iterative Design Proposal, an equivalent design project context) and thus they may proceed to implement this assignment addressing the needs thereof.

S Studies carefully the design project context and presents system diagrams representing the design solution as a complete system (System level design).

S Details aspect of the system and its subsystems, taking care to draw working sketches of each part of the system (component level design) which conceptually show functionality of each subsystem.

S Produces working drawings relevant to the system being developed.

T Guides students in considering realistically resources and processes available to implement their solutions. Provides a sample Component/ materials list for guidance.

S Compiles a Component/ Material information sheet highlighting the required resources to implement the working drawings of their solution.

Step 2 - Prototyping

T Guides students to safely use workshop equipment and schedule use and distribution of materials required.

S Produces a manufacturing plan relevant to the Design solution.

T Guides students on the following selection of elective manufacturing areas that may be relevant in prototyping their individual project. **TWO** elective areas from the following list shall be assessed for each student:

- Microcontroller Systems
- Mechanical Systems
- Electronic system construction
- Constructing complex forms
- CAD/CAM

S Selects **TWO** relevant elective manufacturing areas, implements them as per guidelines below, and performs the required work under supervision, taking care to follow all H&S requirements, in order to produce a working solution/s.

Note: While prototyping is expected to include both elements simultaneously, assessment is divided in two parts:

- Prototyping: the implementation of the two selected manufacturing areas;
- Making process: the students' performance during manufacturing.

S Considers modification to the development section that may have been required during manufacturing and submits the development work for assessment.

T Assesses the development work and any prototypes, the functionality achieved in the selected elective areas and eventually the manufacturing performance of the student.

Note: The implementation of this assignment requires the access to a suitably managed school Design and Technology workshop, equipped with a range of tools, machines and equipment, design exploration areas, CAD-CAM and ICT equipment, all installed in accordance with all required Health and Safety provisions applicable. Teachers are recommended to implement an approach of mixed-activity-learning in order to address tasks efficiently and safely.

Section 1: **Design Development**	
Detailing a solution	This section should include: - the design of a system diagram which includes the input, process and output parts of a proposed project design idea; - a clear and conceptual indication of whether sources of power or external forces are required for the functionality of the system (where applicable); - a design of the proposed system at component level, in the form of working sketches, for each sub system (this may include mechanical, electronic or combined systems).
Development information	This section should include: - working drawings for parts of the solution which include accurate design information (consideration of component interaction, tolerances, any required calculations, material and/or components used); - a Component / Material information sheet which includes a list of components and materials used in the solution and their respective characteristics/properties relevant to the solution, adequately referencing any source (Tables, Data Sheet) used; - detailed Cutting and Component Lists for each part of the proposed solution comprehensively guiding manufacturing. *These two lists may be presented as a single list.*
Section 2: **Prototyping**	
Planning for making	This section should include: a sequential manufacturing plan for the proposed design solution, presented in a graphical manner. (E.g. Gannt chart, table, etc) taking care of distributing the time allocated in a realistic manner.
Prototyping	In this section students are expected to select TWO relevant elective manufacturing areas from the following options:
	Option 1: **Microcontroller Systems** If this elective area is selected, the student should: - implement and simulate a functional microcontroller system that is programmed uniquely for this project to satisfy a required need, including a documentation of modifications done to improve efficiency. (E.g. simplifying a flowchart circuit, reducing components, etc.)
	Option 2: **Mechanical Systems** If this elective area is selected, the student should: - implement a working mechanical system considering tolerances, functional assembly, and interaction between parts/members, and document a minimum of one modification to improve efficiency. (E.g. adding bearings, using lighter materials, manufacturing custom parts, etc.)

	Option 3: **Electronic system construction** If this elective area is selected, the student should: - implement a working electronic system considering circuit construction (fitting a required size), neat assembly, interaction between components and documents a minimum of one modification to improve usability/efficiency. (E.g. modular circuits, use of connectors, PCBs, efficient component use, etc.)
	Option 4: **Constructing complex forms** If this elective area is selected, the student should: - Construct parts to satisfy complex forms required for a project. Prepares moulds, formers or surface developments required to implement a good quality complex form and document a minimum of one modification to improve form interaction with other components. (E.g. Constructing a Vacuum forming mould, constructing an accurate surface development in sheet material. Modification may be an adjustment/iteration in dimensions or tolerances)
	Option 5: **CAD/CAM** If this elective area is selected, the student should: - Design accurate parts using CAD software to satisfy the manufacturing of custom parts as templates or digital files for CAM equipment and document a minimum of one modification/iteration done to improve overall precision (E.g. 3D Printing, Laser cut parts, Digital graphics, CAD circuit design and CAD-CAM circuit construction. Modification may be an adjustment/iteration in material tolerances, layout, in-fill, production).
Making process	During the implementation of the selected elective criteria, the student should: - use equipment and the workshop environment safely and appropriately taking care of the Health and Safety for each process - use of adequate PPE. - Use materials and components with minimal wastages. - develop the parts to a fair degree of accuracy and functionality - manage and organise the parts to construct the prototype referring to the planned procedures. - tidies up and cleans equipment used after completion (*Note: The prototype refers to a functional model of the solution, which shall later be finalised into a final, finished and tested product.)*

References

Banks, Frank & Owen-Jackson, Gwyneth. (2007). The role of making in design and technology.
Sousa, D. A (2016). How the Brain Works. Crowin Press. 2016

Exemplar 5: Iterative Testing, Finalisation and Evaluation

Iterative Testing, Finalisation and Evaluation	
	Defining the Iterative Testing, Finalisation and Evaluation The *Iterative Process of Testing, Finalisation and Evaluation* assignment on its own is intended to explore the practice of quality improvement in a finalised product, testing and introducing critical evaluation as a means to develop the skills and knowledge of the student, reflectively. This assignment builds on an explored design problem, a proposed design solution (E.g. a project proposal, a fully defined project idea) and on a manufactured solution which needs to be further finalised, improved and evaluated (e.g. the product developed during the Development and Making assignment, a completely developed and manufactured product addressing identified specifications). Overall this assignment compliments and is a final stage in the learning experiences related to the holistic *Iterative design Process*. Students finalising a design solution shall document the Iterations required based on testing carried out and finally reflect on their work and experience through evaluation, critical thinking and by suggesting further future projections for their solution. When working on this assignment, students may refer to other coursework material carried out previously or relevant stages of the iterative design process (e.g. explored design problems, design solutions, proposals, prototypes, etc.) to substantiate their product evaluation, self-evaluation and further critical projections by using such material in the form of references, annexes, quotes or illustrations. Digital files (e.g. a digital project proposal) may be referred to but for direct reference, screenshots are recommended. Through the use of adequate testing and further finalisation, a student makes iterative leaps as an already developed prototype is analysed, new improvements are designed and thus the final product presented by the student is evidence of multiple cycles within a holistic iterative design process. The evaluation section fosters critical thinking skills, let alone opens a new cycle for what could be future innovation with the proposed design solution. All this contributes to the self-development of design and technology skills and reinforces the iterative approach of Explore, Design, Make and Evaluate as a holistic design process. **Implementing the Iterative Testing, Finalisation and Evaluation Assignment** The Iterative Testing, Finalisation and Evaluation assignment should include the following three steps/sections, developed as per guidelines further explained below: • Testing • Finalised Making • Critical Evaluation The Iterative Testing, Finalisation and Evaluation Assignment can be implemented in class, as explained in the following steps (T - teacher, S - student): ***Step 1 - Testing*** T Ensures that all students working on this assignment identify and select a completely defined product concept (e.g. a project proposal, a fully defined project idea, an equivalent fully defined project concept), which they have produced themselves and its relevant manufactured artefact/solution (e.g. the product developed during the Development and Making assignment, an equivalent, completely developed and manufactured product addressing identified specifications).

	S Identifies and describes the aims TWO relevant product testing tests based on the claims found within the project concept (these claims are typically evident within project design ideas, detailed material/component data-sheets, specifications, etc.) S Carries out and documents planned tests appropriately, and their results, respectively, within the school workshop. T Guides students in determining the final iterations required to present their finalised Design solution. These should consider test results, time and resources available and the user requirements identified at earlier stages. ***Step 2 - Final Making*** S Presents finalised product design drawings which communicate any final iterations/modifications and finalisation work required (e.g. assembly, finishing, any branding, etc.) S Performs manufacturing processes, in the school workshop, to finalise the design solution, any additional modifications or improvements previously identified and any further components required to present the artefact as a complete product. S Compiles ONE user information document which communicates useful information related to various aspects, such as: the general use, care and maintenance of the product and display of product features. This may take the form of: • A User Manual OR • A Care and Maintenance Manual OR • A Product Leaflet Selected document can be presented as per guidelines below. S Presents the user information document as part and parcel with the Design solution. ***Step 3 - Evaluation*** T Guides students to carefully be aware and respect deadlines related to the presentation and submission of this assignment, since this occurs at the last stage of their SEC course. S Refers to material previously submitted or adopted during the Iterative Design Process as the basis on which work on this assignment was referring to. S Develops and writes a project evaluation which includes references to any stages within the coursework done related to the development of Iterative Design Process. The Project evaluation needs to include the following sections: • A Product evaluation • A Self Evaluation • A Critical Projection *Note: The implementation of this assignment requires the access to a suitably managed school Design and Technology workshop, equipped with a range of tools, machines and equipment, design exploration areas, CAD-CAM and ICT equipment, all installed in accordance with all required Health and Safety provisions applicable. Teachers are recommended to implement an approach of mixed-activity-learning in order to address tasks efficiently and safely.*

Section 1: **Testing**	
Product testing	This section should include: - a description of the aim of two product functionality tests to be carried out (e.g. *Ergonomics, circuit functionality, mechanical performance, etc)* on the prototype of a self-developed design solution related to the claims specified in the proposed product design; - appropriate performance and communication of the actual carrying out of the planned tests (e.g. sequential list, photographs, infographics); - appropriate communication of test results (e.g. table of results, photographs, infographics).
Section 2: **Final Making**	
Final Design Iteration	This section should include: - A visual communication of the final design/s of fully developed product/prototype taking into consideration the results of the Product tests performed and/or any proposed modifications or quality improvements, resulting from the above, including reference to: - finishing details (colours, decals, textures, etc); - modified components/parts (if applicable); - any functional modifications or quality improvements. Note: Where no functional modifications are identified or needed, focus should be placed on ONE quality improvement only. (E.g. of quality improvements: material properties, sustainability, aesthetic or marketability properties).
Finalised product	This section should include: - A finalised product which represents the functional design solution and reflects the proposed system/s, addressing previously identified needs in the form of a physical artefact, including: - an assembled physical product; - appropriate finishing; - aesthetic / branding details; - any other relevant components that are required to present this as a complete product. (e.g. a product stand, a base, labelled user inputs, etc).

	User information	This section should include ONE of the following: **User Manual**: a one-page user manual which highlights how a proposed, finalised product may be operated appropriately, showing parts and basic steps to use such product and basic safety warnings. (excluding any promotional, maintenance / replacements required) **OR** **Care and Maintenance Manual**: a one-page User Care and Maintenance manual which highlights how to service, clean or maintain a proposed, finalised product appropriately, using simplified graphics & infographics and essential safety information. (excluding promotional or usability instructions). **OR** **Product leaflet**: a promotional document in any format that reinforces brand presentation, highlighting the product's benefits, visually, directed to a specified target audience. (excluding any usability instructions and maintenance/ replacements.
	Section 3: **Evaluation**	
	Product Evaluation	This section should make reference to the following critical product aspects: - reference to any material within the holistic Iterative process leading the development of this product and how the final product satisfies the original needs and the target user; - its design and manufacturing; - the product feedback received during any stage; - the tests performed; - a review of the final production level of the solution and its functions.
	Self-Evaluation	This section should include: a critical self-evaluation reflecting upon the iterative design process carried out, manufacturing experience (E.g. 5s) and self-development gained during this project.
	Projection	This section should include: further possible development of the product focusing more or beyond the original needs, suggesting how new and emergent technology may be applied to achieve this potentially.