2024 ASSESSMENT REPORT

EDN315123 ENGINEERING DESIGN

General Comments

The folios that were assessed in 2024 were in general of a slightly higher standard than last year with significantly fewer students only achieving t's or z's. It was also noted that fewer students submitted incomplete or unfinished folios. The manner in which they were structured and formatted was generally a clearer narrative of the documentation of the design process and allowed for clear and more consistent interpretation and marking.

There was a broad range of projects with some strong themes evident (storage container projects and hydro turbine projects) as well as a similarly fascinating spread of various projects as seen in 2023. Projects still varied greatly in quantity and quality, and it was noticeable that there was a greater proportion of physical prototypes designed and produced than digital or software-based projects.

Criterion 1: Apply critical and creative thinking to the design of a solution

This criterion has several elements that relate directly to the problem and the solving of it through design.

As last year, students that achieved a higher result were able to present a succinct problem to analyse and solve that was then incorporated into the design brief and referred to throughout the rest of the folio.

It was felt that some of the less successful folios showed little evidence of being informed by the design brief and problem and focused on producing a product or object. They presented like a "solution in search of a problem" – meaning that the student wanted to make a particular project and hadn't been able to show that it was actually a "solution to a problem".

It highlighted the importance of brainstorming, deciding on and defining a problem that allowed for broad research, multiple and varied iterations and then a prototype that could be tested and modified. Strong problems most often identified a client and had strong links to elements in Criterion 8 (see page 5).

Criterion 2: Apply an iterative design cycle to develop engineering design solutions

The slightly higher proportion of students to undertake and complete projects with a physical prototype compared with digital or software product and the change of one of the elements from last year may account for the slightly higher results seen in this year's mark spread.

Successful students not only undertook and completed a prototype that was then able to be tested and modified before evaluation, but they also had comprehensive design specifications in their Production Proposal. This included not only a Gantt chart and list of the resources (equipment, materials and costs) but also a risk assessment that was comprehensive and reflected upon after the production of the prototype. It is recommended that the entire design specifications be reflected upon as to what may have changed (or been adapted) between the proposal component and the final design component.

Students who were less successful in this criterion often did not complete the prototype and/or were unable to test and modify it. It is recommended that teachers encourage students to limit the size, complexity and scope of their prototype and carefully sequence the production so that they have time to organise, undertake and complete it. This was often reflected in a 'token' Gantt chart that illustrated that the student had 'ticked the box' but probably did not understand the project management requirements to achieve the production timeline. Equally, risk assessment documents generated by a generic program were often very limited in their relevance and were often viewed as the barest minimum to fulfil Element 1.

Most physical projects had many different tools and equipment (E02) to list and comment on as well as associated safety considerations (E01), specifications (E03) and prototype production (E04) to document, analyse and reflect upon.

As mentioned last year, some of the assessed folios and projects illustrated that students are very fortunate that they have teachers, collaborators and available resources that allowed and assisted them to produce their project and to achieve the best possible outcomes. It is recommended that students explore the available collaborators, expertise, skills, materials, equipment, software, hardware, workshops, processes and other resources at their school so that they have a clear understanding of what they can produce or model in the time available. If necessary, they should reduce the scope of their proposed design to take this into account.

Criterion 4: Use success criteria to review, reflect on and refine the design process

There was a significant improvement in the results in this criterion compared to last year's. Many students though still failed to understand the need for clear success criteria and their relationship to the problem.

The context of the issue and associated client should be used to define a succinct problem; solve the problem and the issue is resolved and the client is 'happy'. To solve the problem there should be aims that need to be met. These aims should have measurable outcomes that make it possible to determine if they have been met – these are called success criteria. The success criteria should directly relate to the aims. The success criteria should be realistic and measurable. Think SMART goals.

An example might be that:

Context and Client: "An elderly disability pensioner living at home with a physical impairment requires a method of hanging his washing and raising and lowering it to dry as he is unable to lift his arms over shoulder height."

Problem: To design an adjustable height clothes hanging system operable by a person with additional physical needs.

Aim 1: It should be cheaper than what is available at Bunnings and of comparable quality.

Success Criteria 1: It should cost less than $150 and support 30kg.

These aims and success criteria should be used throughout the design process. Students should analyse the existing products and solutions available as to their relevance to the analysis of the design development iterations with PNI (positive, negative, interesting) and/or client/stakeholder feedback and/or surveys. The prototype needs to be tested against the success criteria with some measurable/numeric values that can be compared to the success criteria values required to achieve the aims or to inform improvements and modifications that will meet them. Physical prototypes while possibly easier to test, are probably more time consuming and complex to undertake. If designing and making a non-physical design (digital prototype or theoretical concept/construct) the testing needs to be against the success criteria where there can be a demonstration that they either meet the success criteria or that there is an improvement. If it is not possible to determine measurable/numeric values that can be compared to the success criteria values and to show improvement, then students need to determine other methods of measurement. This could include feedback, expert opinions, surveys, software modelling and digital testing. This is where it is highly recommended to have a client and/or stakeholders that can provide feedback and advice to the students on their designs and prototypes.

Successful students were able to demonstrate this as well as demonstrating the application of this information (E01&E02) to the production and modification of the design and prototype (E03) to optimise their final design solution and were able to justify this.

Less successful students may have completed a prototype but either ran out of time to test, did not analyse the testing that was undertaken and/or apply it to modify their initial prototype to optimise it. It was difficult to determine whether this was due to a lack of time management or interest from the student once they had a ‘completed’ the product.

Criterion 5: Communicate for technical and non-technical audiences

Similarly to last year, students who achieved the highest marks (of which there were significantly more) demonstrated a full suite of communication skills throughout their folio to explain their design and document the process. Lower achieving students’ folios may have been very text dense with few images, drawings or models to illustrate their points or relied heavily on illustrations but neglected to include explanatory annotations to explain their relevance to the criteria being assessed. There was a curious dip in this year’s ratings in the “B” marks range.

Many of the “A” students included a video. The video, while not required, is highly recommended if it helps to explain and demonstrate how the prototype actually works and functions. Several folios benefitted significantly from having provided a video that did this. It was also felt that several other folios (especially “B’s”) would have benefitted from a video as the folio had insufficient detail to ascertain as to the functionality of their prototype.

Videos need to be (as described in the External Assessment Specifications) submitted with the folio pdf file and zipped prior to submission. Markers would recommend that they be a maximum of three (3) minutes in length or shorter and kept succinct and on subject.

Several folios were not zipped and there were several folios that contained videos as SharePoint links that were not viewed as they had not been correctly submitted. 'Live links' should not be used in folios. Only what is visible in the folio will be marked. Markers will not access links to outside the folio – for safety, security and fairness. This includes video and website links. The reason for this is that it was felt that this may unfairly advantage some students if they were able to update files and have more time to produce a more polished video at a later date as well as link to more pages over the 40-page maximum limit. Please follow the requirements specified.

If students use a landscape format for the presentation of their folio, they must avoid large blocks of text. Reading across the page on a small screen is often difficult. If this format is chosen, particularly to efficiently present drawings or models, text/pages should be divided into 2-3 columns or text boxes with max 12-15 words across the column or box as standard. Subheadings within the various components can be used if it helps to further break up and/or clarify the text and folio.

Some students were marked down due to poor referencing. In some cases, referencing is not only used to differentiate between the student's own work and external sources, but also to highlight the input of stakeholders and clients. In one case this may have been the difference between a "C" and an "A" due to not using the references to support those changes made to designs and prototypes was on the advice of a stakeholder rather than the reflection of the student. Students must correctly reference all graphics, modelling and analytical software used.

Criterion 8: Analyse the interrelationships between engineering projects and society

The results that students achieved in this criterion were very similar to last year. This is a broad criterion and many students had difficulties in comprehensively addressing all the elements successfully.

Students who received a high mark invariably started with a client in mind and a strong problem that had much scope for research, analysis and design in the process of finding, proposing, presenting and explaining/justifying their solution. These problems encouraged innovative (E01) analysis and design of existing products (E02) not only in the Research Essay, but throughout the design process and was often referred back to in the Aims in relation to the "Social, ethical, economic and environmental issues" (E03). While not all four parts of Element 3 had to be comprehensively covered throughout the folio, at least two needed to be explored and addressed in-depth to achieve a "C" standard. Few folios addressed Element 4 in any depth and it was agreed that it would be disregarded in assessing student's on-balance rating for Criterion 8.

Weaker students often missed any analysis or explanation of the existing examples that they presented in their research and used little of it to inform their latter design decisions. These examples did little to explain how their solution built upon existing products/solutions.

General Observations of the Folios

Students, with staff support, should consider their “design folio” as a “design story”. It reads better and makes more sense to the reader if it closely follows the framework and structure outlined in the External Assessment Specifications. If it is out of sequence and is difficult to follow, there is a possibility that marks will reflect this rather than the work undertaken.

The Design Folio is a narrative describing the design journey using text, numbers and drawings, images, models, and prototypes from the context and client. This narrative is further developed through researching related and existing problems, possible solutions and products, and a student’s design ideas and iterations. The narrative is then continued using prototypes that are tested and improved (modified) to a final design solution that solves the problem through fulfilling the identified aims.

All folios must be submitted as pdf files and zipped together with the video (if there is one) before submission. There were several that were not. There were also several folios where it was possible to identify the individual students. Staff and students need to be conscious of this and thoroughly ensure that folios are deidentified. Schools can be identified as “The School”, the teacher or aide by their first initial (“Mr D” or “Ms P”) in a similar manner to clients and stakeholders (“Mr X from ACME Engineering”). Likewise, photos should be carefully framed or cropped to avoid identifying backgrounds.

Title Page

Some title pages were extremely spartan in content, containing only a generic title (such as “Major Folio”) and the student’s TASC ID Number. While this is acceptable, students are encouraged to include the title of the actual project and possible [one sentence] descriptor of what it is (e.g. “Storage Solution” or “Hydro Turbine”).

Design Brief

Evident this year, and stated last year, higher achieving students were able to articulate a good problem. Their problem was open-ended and easily addressed Criteria 8 Element 3. Less successful folios were exemplified by the project focusing on a product or object as opposed to a problem, design challenge or issue and often did not identify a client. Advice to students would be to focus on the problem not the product. Students should aim to have a single sentence problem statement (succinct but sophisticated) that is taken from the introductory context statement and client.

Having a clearly defined ‘client’ that the problem needed to be solved for, who had clear needs and wants, was a definite advantage. Students who then carried out an in-depth discussion of the client’s (user’s) needs, providing a strong rationale and analysis exemplified students who were awarded B’s and A’s. From these statements students would generate their aims and objectives which should really reflect the context of the user’s needs.

These statements should be followed by 3 – 6 main aims the need to be fulfilled to address/solve the problem. These should be continuously referred to throughout the folio as method of justifying decisions. The aims should be formatted as a list. Numerating them is recommended as it aids in the referral process throughout the folio. The aims should be referred to throughout the folio. For

example, “The research example demonstrates aspects that meet the requirements of Aim 1” or “It is recommended that to meet Aim 2, that … be changed”.

Each of the Aims in turn should have realistic and measurable success criteria. This was mentioned earlier in Criterion 4. These aims should have measurable outcomes that make it possible to determine if they have been met and should directly relate to the aims. By having aims and success criteria numerated it is possible to directly relate them.

An example might be that:

Context and Client: “An elderly disability pensioner living at home with a physical impairment requires a method of hanging his washing and raising and lowering it to dry as he is unable to lift his arms over shoulder height.”

Problem: To design an adjustable height clothes hanging system operable by a person with additional physical needs.

Aim 1: It should be cheaper than what is available at Bunnings and of comparable quality.

Success Criteria 1: It should cost less than $150 and support 30kg.

These aims and success criteria should be used throughout the design process. Students should analyse the existing products and solutions available as to their relevance to the analysis of the design development iterations with PNI) and/or client/stakeholder feedback. The prototype needs to be tested against the success criteria with some measurable/numeric values that can be compared to the success criteria values required to achieve the aims or to inform improvements and modifications that will meet them.

Research Analysis Essay

The research analysis essay must be related to the context and client statement, the problem and the aims. The key is also in the heading. There needs to be analysis of the topics and existing products researched. Essays should also contain images diagrams, technical drawings and other illustrations across a range of mediums to illustrate the research undertaken. Markers found it difficult to effectively wade through huge tracts of poorly formatted text.

Students who received higher marks researched and analysed the topics outlined in the External Assessment Specifications and demonstrated research that was directly related to and informed the design process and solution. It was linked back to the aims and also discussed the success criteria. This research could then be seen used later in the design development.

Students who were less successful undertook research that was general in content and not explicitly related back to the problem and aims. Occasionally research was off topic and almost seemed as padding to complete a word count requirement. Students who included unrelated information to fulfil their wordcount did not improve marks.

Design Development

Students who received higher marks again clearly presented multiple different iterations of their design ideas with annotations describing how they solved the problem(s) and addressed the aims and met the success criteria. The iterations showed a progression of ideas and development towards the prototype production and the latter final design.

It is recommended that students include at least three (3) different design iterations developing upon each other and documenting a progression of ideas. Each should be annotated analysing the “Positive”, “Negative” and “Interesting” and/or using colour codes (green, red, blue respectively) and linked to individual aims and success criteria. Much of this analysis can be a reflection by the student on their design(s) but does not preclude the input from stakeholders or the client.

Students who started the process with a product in mind often found this stage difficult as they already had a final product in mind and found it difficult to propose different iterations or present a progression of design ideas.

Students designing and producing a game or digital product must show iterations on the development of the project and/or program. This can be documented through initial sketches and/or screenshots of the design development stages of the game with associated annotations (as previously described). There were several digital based design folios that demonstrated this design iteration process very well.

Production Proposal

As already mentioned in Criterion 2, successful students had comprehensive design specifications in their production proposal. This included not only a Gantt chart and list of the resources (equipment, materials and costs) but also a risk assessment that was thorough and was again reflected upon after the production of the prototype. It is recommended that the entire design specifications be reflected upon in the evaluation as to what may have changed (or been adapted) between the proposal component and the final design component. An example of this could include the costing (budget) and how, where and why it changed. Less successful students either missed parts or paid ‘lip service’ to the information requested through token charts and lists that were often very generic in content.

Design Production

This is not a journal of what the student did but rather a documentation of how the prototype was produced, tested and modified/refined. A short section of the video could be utilised to document this (if a video is selected).

Successful students completed their prototype(s) and documented and demonstrated their testing and then presented and analysed their data using different methods. This information was then compared against the previously stated aims and success criteria to see if they were met and therefore the problem ‘solved’. They were able to articulate the refinement of their prototype against this information and were able to clearly show and justify how and why they modified their prototype to refine them (through several iterations in some cases) to reach their Final Engineered Solution. Non-physical projects (design concepts or digital projects) undertook successful testing through stakeholder engagement (such as surveys) and client feedback (advice). This needs to be carefully and accurately referenced. All testing should follow the scientific testing methodology and be replicable by someone else so that it could be verified and valid. Online surveys of 2-3 people do not meet this requirement.

Less successful (Criteria 2 and 4) students often did not complete a prototype, undertook minimal testing or analysis, modification or refinement, and/or ended up with a Final Engineered Solution in one step.

Students who were unable to complete their prototype were still able to succeed if they comprehensively reflected on how and why they were unable to complete their prototype and offered suggestions as to improvements and refinements to improve the process and their design to better meet the aims and success criteria so as to solve the problem as well as include feedback from stakeholders.

Final Engineered Design

As stated last year, successful students were able to clearly document and present their final design solution, be that a physical prototype, design project or digital product, that was successfully resolved to the best of their abilities against the problem and design brief (stated aims and success criteria). They contained comprehensive presentation of images, diagrams, models, technical drawings and other illustrations across a range of mediums with annotations explaining them.

Again, less successful folios presented a final design solution that demonstrated minimal resolution and/or was unable to successfully address the original problem and design brief (stated aims and success criteria) convincingly. Often their presentations lacked images, diagrams, models, technical drawings, and other illustrations across a range of mediums with minimal annotations explaining them.

A change this year was that there was no requirement for a video. It was recognised that for some students it is extremely time consuming and stressful to produce. While not required, it is evident that for some projects of a functional mobile or digital nature (e.g. game or interactive software) a video can demonstrate the prototyped solution in action and how it actually works. There is no penalty for not providing a video, but it might be difficult to achieve the highest grades/marks possible. The video should not be included as an embedded link within the folio and it will not be opened or viewed. It must be submitted as a separate file and zipped with the folio for submission. It must also be thoroughly deidentified (as previously described).

Evaluation and Recommendations

As stated last year, successful folios clearly documented and articulated the evaluation of the solution against the problem and design brief and how each of the client's needs, aims and success criteria were met and/or exceeded. They reflected on what had been achieved as well as where there were issues or problems. Students made suggestions and recommendations as to where redesigns and/or further testing, modelling or research could be undertaken to improve the design solution further. Some students mentioned what they had learnt and what they would do differently next time.

Less successful student folios often only addressed one or part of one of these aspects in a superficial manner. It is strongly suggested that students focus on this component especially closely if the prototype was not completed or does not work as planned or predicted. Students should offer reasons for why it doesn't work as well as insights and reasons (not excuses) to improve the design process and solution further so as to successfully address the aims and success criteria and therefore the problem and brief.

As an aside, students should be prepared to revisit their design brief as part of the editing process. This is especially the case for aims and success criteria if the design has 'evolved' and they are no

longer relevant to the final engineered design. The design brief may need to be pared-back and reframed so that the folio reads better if necessary.

References

Overall, the referencing was well undertaken. Use of an online reference generation tool is highly recommended (such as Cite-Me) and should be used consistently throughout the folio process. Students should avoid waiting until the end to undertake referencing.

As mentioned last year, all images should be clearly referenced so that there is no ambiguity as to whom took or constructed the image, model or video. Students should label all their own work as well (e.g. “Author, 2023”) to avoid confusion.

As mentioned previously, some students were marked down due to poor referencing. In some cases, referencing is not only used to differentiate between the student’s own work and external sources, but also to highlight the input of stakeholders and clients. In one case this may have been the difference between a “C” and an “A” due to not using the references to support those changes made to designs and prototypes was on the advice of a stakeholder rather than the reflection of the student. Cite-Me has a section where advice from external sources (people/organisations) can be correctly referenced. All graphics, modelling and analytical software used must also be carefully referenced.