Bioengineering Portfolio
Design and Professional Practice

Faculty: Engineering

Department: Bioengineering

Module name: Design and Professional Practice 1

Degree: Biomedical Engineering, Molecular Bioengineering

Level: Yr 1

Academic years: 2020 - ongoing

Format: Portfolio, submitted as individual coursework

Approximate number of students: 180

Delivery mode: some in-person, mostly online

Duration: Autumn and spring term of Y1

Weighting and credit: Portfolio accounts for 40% of the module

Module ECTS: 5

Insights colour key

Educational Developer

Inclusivity

Learning Designer

Registry

Careers

Assessment overview

The Portfolio assessment is designed to help students in Biomedical Engineering and Molecular Bioengineering develop key professional practice and design skills, which will be critical to their personal development throughout their degrees. Active learning and group work are cornerstones of the teaching approach for the module. Professional practice includes: verbal communication; written communication (including emails); reflection (e.g. how you perceive and act on feedback); engineering ethics; teamwork.

Design skills (specific technical skills) includes: using particular engineering software's to design something; Tear Down, e.g. breaking something down and seeing how it works and how it was made; technical drawing.

The module is structured on Mobius, with regular assignments that can be completed in the students' own time. There are no structured lectures each week; the module co-ordinator gives an update at the start of week, reminding students about the tasks for that week. The assessment is formed of frequent assignments (one per week/per fortnight), with no set deadlines through the term. Part of the professional practice skill set is that students learn to work asynchronously and manage their own time. The Portfolio is primarily assessed individually, except for one group task on engineering ethics. Students are given formative feedback on aspects of the Portfolio through the term, then given a summative assessment at the end of the module.

For boarder discussion of peer marking, peer feedback and groupwork please see this case study.

Design decisions

Assignment design

The portfolio collates a series of tasks that students perform throughout the duration of the module. These tasks involve:

- Reflection assignment: Students prepare a short, written report that they submit to their Personal Tutors for formative feedback at the start of the module. The first reflection assignment asks them to reflect on the process of report writing and the feedback from their peers and their tutor. There is a second piece of reflection, based on the outcomes of a group design project, at the end of the module.
- Quizzes: online multiple-choice questions that relate to a series of videos; students are given summative (yes/no) and some formative feedback on these, and are able to have multiple attempts.
- Tear Down: taking apart an object to interrogate its design features and reflect on the design choices and manufacturing process
- Sketching: A short sketching exercise to help students practice their sketching skills and to encourage using images as an efficient way to present technical information.

Interviewee: Maria Parkes (interviewed by Monika Pazio; write-up by Emma Passmore)
Role: Senior Strategic Teaching Fellow

Anatomy of Assessment

Bioengineering Portfolio
Design and Professional Practice

- Presentation: Students give a 5-minute verbal presentation to their Personal Tutor, on an area of Bioengineering that they are interested in. The tutor gives formative feedback, then the student makes a recording of the presentation and submits that for summative assessment.
- Technical Drawing: using Solidworks; Part of the portfolio is an introduction to the software, including a video recording that students watch, plus a tutorial that students need to complete. Students then complete a task/build using the software to show that they can use it, and as a final task they complete a drawing. The task takes place over several weeks, during which students can access support sessions with GTAs (based in a computer room) who will answer their questions. Marked by a GTA using a numerical rubric.
- Engineering Ethics: An introduction to ethics in engineering through a scheduled workshop after which students work in tutor groups to create a report answering one of four ethical questions relevant to Bioengineering. The group are encouraged to seek feedback from their tutor on their draft report.

When choosing an assessment diet for the course it is important to consider the ECTS value. A 5 ECTS course requires 125 hours of effort. It is important to reflect whether the proposed number of assessments is appropriate for the amount of effort indicated by ECTS. Watch this video on how to avoid over assessing students.

The team recommend a schedule to complete these assignments which spreads the work throughout the year.

Rationale for the design

The Portfolio approach is an authentic way of assessing the design process, rather than using a series of quizzes or exams. This approach encourages students to ask questions, to research materials and to be critical. The Tear Down – where students take an object apart to interrogate its design features - encourages students to think in a broad and creative way about objects. Professional Practice skills are best developed by doing, rather than by passive learning, e.g. the experience of giving a presentation, watching a recording of yourself doing it, then receiving feedback is more powerful than sitting in a talk about how to give a talk. The Portfolio approach also encourages students to develop their reflection skills, which is very different to how students are taught in a school environment. This module gives students room to reflect on their progress, and to receive feedback on the quality of that reflection.

From the careers perspective, one needs to be self-reflective in order to first secure a position. This involves the ability to break down experience, justify it and explain it in a job interview. Secondly self-reflection is important to progress through career. Professional development activities need to be completed on an annual basis and reflection is an important part of that. Most employers these days are asking for students to be reflective because this indicates that those students are not afraid to speak up when they make a mistake.

Students in Y1 may not understand that there are different kinds of feedback, e.g. some students don't realise that verbal comments from their Personal Tutor on their presentation is a form of feedback. The Portfolio teaches students about different kinds of feedback, which is useful for other modules. It also teaches them time management skills, and aids their transition from school-style learning (e.g. highly structured and scaffolded) to undergraduate-style learning (e.g. asynchronous, more independent).

Students' experiences of feedback vary and influence their perceptions of what feedback is. It is important therefore to establish a common understanding around feedback and the many forms and many sources it may come in from the start. This will have impact on students' overall experience on the programme.

Personal Tutors play an important role in this module. They meet their tutees every fortnight through year one. Tutors provide important feedback on students' language and comprehension skills (and handwriting!), when they provide formative feedback on written work. This helps to forge their academic relationship, and also helps to reduce the marking load for this module.

Anatomy of Assessment

Bioengineering Portfolio
Design and Professional Practice

Rationale for delivery method

There are no structured in-person lectures associated with this module; students can access the lessons and assignments through Mobius on Blackboard. Some elements of the assignments are completed in-person, e.g. presentations to tutors, whilst others are completed online, e.g. quizzes that feed into the Tear Down. Two short workshops on engineering ethics and the Tear down assignment (one in each term) allow students time to explore these areas through group work before completing the assignment in their portfolio. The reason for this delivery method is that it allows for asynchronous learning.

An assessment diet that gives students an element of freedom as to when complete elements of portfolio can be tricky time management wise. While the flexibility is important, it is good to give students an indication of how they should be progressing with a suggested timeline to scaffold their development of time management skills.

Rationale for the software used

The module was originally delivered using OneNote. Using OneNote you can create pages and copy them to student notebooks, embed videos and embed quizzes through Microsoft Forms, you can have uploads, and it works nicely with the Teams platform. However, with 180 students, OneNote wasn't syncing efficiently and getting glitchy.

Mobius (a platform within Blackboard that is usually used for numerical modules) works well for the Portfolio. The platform is built as teaching software and therefore has useful features, e.g. there is a grade book, so you can perform simple progress analyses by looking at how students have performed across one assignment, or how an individual student has performed across multiple assignments. It is easy to see if most people got the same question wrong in one of the quizzes, and then quickly offer group feedback on that question. The software has built in rubrics/marking tables, which is a useful functionality for the markers.

It is useful to consult the Faculty Ed Tech team on how to optimize the tools used in the portfolio to make Blackboard the portal for all the technologies. With a variety of assessments that a portfolio format allows, it is important to also think about the instructional design around the activities on... the platforms. It's important to put yourself in the shoes of the students to understand the pathways through the content they may take to make sure they understand how to optimally move between the activities and tools. Having clear links and clear explanations is key.

There are some disadvantages to Mobius: uploads are still sometimes problematic, e.g. if a student hasn't followed the naming convention properly, or is trying to share a video that has a large file size (the workaround here was to link to an external Sharepoint site); it's not straightforward (but possible) to set start and end dates for assignments.

Mobius can be slow with uploads of big files. The advice in the Faculty of Engineering is for students to use Panopto video assignment option to eliminate some of the issues.

Fit with other assessments and the programme/ module

There are six learning outcomes for the module, five of which (2-6) are covered by the Portfolio. Upon successful completion of this module you will be able to:

1. Explain the engineering design process and use it to develop a design concept to solve a proposed problem
2. Use appropriate engineering tools and software's to develop and communicate design concepts
3. Discuss and evaluate the suitability of different materials and manufacturing methods to realise a proposed design
4. Communicate technical ideas clearly both in writing and orally
5. Discuss the importance of ethics in engineering and give examples of how this impacts professional practice
6. Use feedback and reflective practice to improve your learning and future performance

If an important aspect of student learning on the module is the ability to manage their time well, which is an important part of professional practice, with a built in flexibility to help students develop that skill, it is useful to consider having an ILO that communicate this to the students.

The remaining learning outcome is assessed through the design challenge which takes place in the summer term. This challenge asks the students to

Anatomy of Assessment

Bioengineering Portfolio Design and Professional Practice

Watch these videos on group work:

1. Pros and cons of group work
2. How to prepare students for group work
3. Different ways of assessing group work
4. Advice when implementing group work

work in a group to develop a solution to a relatively simple problem. In previous years this has been the design of a promotional keychain torch that advertises Bioengineering.

Practicalities

Preparing students for assessment

While the portfolio collates a range of tasks that students are involved in, the one that can be particularly new to the students is reflection.

Asking students to reflect on their own performance and the activities that they did is a very valuable part of student learning. It is about making it absolutely clear to the students what the learning outcomes are what the assessment criteria are. Also offering a level of preparation here is important, as it is done with shorter formative opportunities and explicit discussion around reflective models.

One of the first assignments in the Portfolio is a reflection exercise, where students write about a "Joining Us" activity that they undertook in their first week at Imperial. For this first piece of formative assessment the students are not given lots of guidance on what "reflection" entails. They are asked to think about the activity they did and then answer simple questions about it: How did you do it? Why did you do it that way? What feedback did you get from your tutor? Is there anything you would change? Students are then given written feedback at the portfolio review stage about what they write and given a few more prompts on reflective practice before their next reflective assessment. The students are given another opportunity to develop their reflection skills - incorporating feedback from this first assignment - at the end of the module. Here, the students undertake a group design challenge, where they are asked to design a Bioengineering Keyring – they don't need to make this, it's just theoretical – and are asked to reflect on the design process and how well they worked as a group.

Reflection is not something that comes naturally to a lot of students. For this reason it is important to put measures in place to prepare students to think and write reflectively. Having some scaffolding questions, as is the case here, can help students make a good start and direct them towards important things they should consider. Also having formative points where they can get additional guidance about the depth of their reflection is extremely important to give students confidence they are on the right track and eliminate too much description, as this is often the case for those unfamiliar with reflective writing. If reflective writing is not as important as reflective thinking, it is useful to consider other modes than a written piece of work, such as a video/ audio submission.

Students are given lots of opportunities to receive formative feedback on their work, and can choose to act upon it, or not.

Students on the autistic spectrum might find reflection challenging. Understanding personal motivations and awareness of how learning journey had happened can be difficult for these students to flesh out. Students should be offered individual support from the Specific Learning Difficulty Tutors.

Marking arrangements

There are five parts to the portfolio, which are summatively marked by GTAs each according to separate criteria (please see below).

Assignment	Marking Criteria
Ethics Report	• Introduction • Courses of action • Discussing • Structure • Decision tree - clarity and content • References

Anatomy of Assessment

Bioengineering Portfolio
Design and Professional Practice

Technical drawing	• Views • 3rd angle • Features • Scale • Title box • Dimensions • Overall clarity
Tear down	• Materials • Manufacturing • Communication – text and images
Presentation	• Explanation • Structure • Presentation style • Slides/ visuals
Reflection	• Identify • Evaluate • Future work

There are around 180 students on the module, so this is necessary to reduce staff workload; the module co-ordinator second marks to check for consistency. The GTAs mark using a marking rubric, matching each part of the portfolio to the appropriate learning outcome in the rubric. During marking, when it is not clear how the student work aligns to the learning outcomes/ rubric the GTAs leave comments for the second marker.

When marking this portfolio, the assessors are looking for evidence of completing the learning activities and building the intended skills, not on producing a perfect write up of every task, nor of producing perfect products.

Students complete three weeks of online quizzes, which feed into the Tear Down. They gain a summative "contribution" mark (of 5% of the portfolio mark) for completing these, regardless of their performance. Students can re-take the quizzes as many times as they like (or choose not to take them at all; this is part of managing their own learning). Questions are multiple choice, and some come with instant feedback if the student gets it wrong. If students haven't completed the quizzes they will not perform well in the Tear Down as they won't have learnt the requisite skills.

Most of the marks for the Portfolio come from the Tear Down. GTAs mark this against a rubric, which is numerical. There can be some issues here with the rigidity of the rubric, which is not as flexible as just using academic judgement but is arguably consistent when used over multiple assessments. There is admittedly variability in marking some elements of the portfolio (e.g. presentations, reflective writing), but GTAs will flag when a piece of work does not fit well with the rubric, so that staff can check their marking/comments before they go to students. Consistency of marking is achieved by getting the same GTA to mark a single batch of assignments, e.g. the technical drawing exercise, so that they can benchmark the quality of the work they are assessing.

It is undeniably difficult to mark "reflection", as this is very personal to each student, but students are given formative feedback on what types of reflections are most useful.

Formative feedback is offered on work submitted before the end of the autumn term – if students miss this soft deadline, then they do not get given the feedback, which helps to reduce marking load through the spring term.

Learning outcome	Aspect(s)	Criteria
Use appropriate engineering tools and software's to develop and communicate design concepts	Technical Drawing assignments Arduino Assignment	The student has demonstrated use of at least one engineering software to produce technical drawings, code or similar. The work clearly communicates the design concept, with appropriate annotations / labelling / dimensioning.

Anatomy of Assessment

Bioengineering Portfolio
Design and Professional Practice

Learning outcome	Aspect(s)	Criteria
Discuss and evaluate the suitability of different materials and manufacturing methods to realise a proposed design	Tear Down assignment	The student has included a clear discussion of the materials used which demonstrates understanding of the material selection process. The student has included a clear discussion of possible manufacturing choices which demonstrates understanding of common manufacturing methods
Communicate technical ideas clearly both in writing and orally	Individual Presentation Tear Down assignment	The student makes good use of images to support the description of an object, concept or idea. The student explains ideas clearly and concisely in both oral and written work. The student uses an appropriate level of detail consistent with time or word constraints. The student structures their work well to aid in explanation. The student uses references and citations where needed.
Discuss the importance of ethics in engineering and give examples of how this impacts professional practice	Ethics assignment	The student has included realistic examples of ethical issues that impact area of Bioengineering professional practice. The student considers both sides of an ethical argument and can draw on relevant ethical frameworks to help recommend a course of action.
Use feedback and reflective practice to improve your learning and future performance	Welcome Week Reflection Final portfolio reflection	The student has demonstrated use of their own reflection and/or feedback from others to evaluate at least some aspects of the module. The student has clearly identified how they could apply lessons learned in future work

Summary of portfolio assignments and what the students should be able to demonstrate. Marking scheme can be found here.

Anatomy of Assessment

Bioengineering Portfolio
Design and Professional Practice

Feedback arrangements

This module teaches students that there are different types of feedback, and how to recognise and act on that feedback. Frequent formative feedback helps students to develop their work throughout the year, while summative feedback at the end of the module gives them an indication of their progress.

Students are offered written feedback on their work at the end of the autumn term (they are given a soft deadline in December), and are also given opportunities to receive verbal feedback, e.g. from their tutors about their presentation assignment, and from GTAs during drop-in sessions through the term.

Formative feedback is given on written work, e.g. structure, clarity, level of detail. The final report is summatively assessed, so any feedback on earlier written work can be useful and help to improve the quality of the final report, e.g. early written work is often lacking in appropriate figures to illustrate designs or concepts, and students who receive this feedback can then make sure they incorporate more figures into their final written assessment. Early work is often also too wordy, or uses too much jargon; receiving this formative feedback can steer students towards producing a more polished final assessment.

A video blog, or a pre-recorded video presentation of any kind is always a good inclusive alternative to a live presentation as it benefits students who have issues with processing speed. The flip side of having it as the main method is that some students might find video as a barrier. It is useful, therefore, to offer alternatives to this assessment method in the spirit of inclusivity. Alternatives that could be considered is a written piece, such as a transcript for example (if presentation skills are not tested) or an audio version (podcast).

Students are given an optional deadline at the end of autumn term if they would like any additional feedback on work they have already completed. Typically, by this point most students have completed the first reflection exercise, 50% have completed the Tear Down, and only 5% have done the video presentation (ideally, all students would have completed all these tasks by this point). Students are also informed at this point of their progress against the rest of the cohort, e.g. “you have completed 2 tasks; the median for the class is 6”, which can help to motivate those who have fallen behind.

This approach rewards students who have managed their time well, as they receive additional feedback on their work. Some people then choose to change their work based on the feedback received and then re-submit it, whereas others decide to submit their first attempt, based on their feedback.

With an assessment design that is relatively flexible and aims to teach students to develop their time management skills, any additional feedback opportunities need to take into account students who have mitigating circumstances. Further opportunities need to be built in to accommodate students who might have missed deadlines due to circumstances beyond their control.

It is important to ensure that all students have equal opportunities to receive feedback to help facilitate their learning. Formative feedback points should be clearly communicated in advance so that students can manage their time well and decide for themselves whether they want to make use of that opportunity. The value of formative feedback should also be clearly communicated to the students.

Online adaptations

This was a new module for the curriculum review; prior to that, elements of the module existed, but they were not for credit. The module was first delivered in its current format in 2020 and the bulk of the delivery was initially planned for the summer term, using mostly in-person sessions. The Portfolio evolved from the need to adapt this module for remote teaching, e.g. asynchronous, spread through the year, with a few in-person sessions to complement delivery.

Some of the videos that are still used now were recorded in summer 2020, for online delivery.

Advantages of the assessment type

- More authentic than sitting an exam; students learn by doing.
- Weekly prompts give students a guide as to how they should be performing but gives them the flexibility to manage their own time.
- Students learn to be reflective.
- Students learn to act on formative feedback to

Bioengineering Portfolio
Design and Professional Practice

improve their work.
- Even if students do leave tasks to the end of the module this can sometimes be a useful learning experience, if it makes students realise that they could have managed their time better.
- The design process is very authentic in terms of the skills developed.
- Practising individual reflection is extremely valuable as it aligns more with authentic practice that students will experience in a workplace. In terms of professional development doing an individual reflection is common and doing it helps students develop skills to get the job in the first place and work through performance review processes. Watch these videos on reflection:
  1. Why is being reflective important?
  2. The value of group vs. individual reflection
  3. The value of embedding reflection across assessments

Limitations of the assessment type
- Students leave tasks until the end of the module and don't take advantage of the formative feedback on offer. Weekly prompts are provided, but deadlines are not enforced. A couple of students said time management was the most difficult thing, and that they had learned about managing time and the importance of planning, but these are just a few comments from the whole cohort.
- Variability of feedback provided by personal tutors.
- Logistics (of marking, and content delivery) can be difficult because there are so many different elements to the Portfolio.

Advice for implementation
- Work backwards from what you want the students to achieve, and how you would assess that learning outcome;
- Keep an eye on the structure to see where you need to add extra support/give students more time;
- Have a go and see what happens! You can think you've written a clear set of guidelines but can always iteratively improve these as students take the module;
- When deciding on the number of assessments ensure that the work required to perform them can be done within the allocated time as indicated by the ECTS value. It is also useful to take the broader programme level view to identify how assessments on one module overlap with others. This should help avoid over assessing and ensuring that assessment diet is appropriate for the hours of effort;
- It is important to ensure that you have a good instructional design support to optimise the variety of tools used and the instructions around the tasks;
- Reflection can be very difficult for some students so make sure there is sufficient time and resource to prepare students to reflect successfully with some opportunities for formative feedback and enough time for them to apply this feedback to the summative assessment;
- Ensure that support is provided for students with specific learning needs in terms of reflection, group work and peer feedback. Preparing students for group work can help group members be more empathetic towards each other and make them aware of some difficulties others experience that can affect their performance which can be useful for peer feedback.