

University of Sheffield New Approaches Case Study

Main Approach: Project work

University of Sheffield

Department of Mechanical Engineering

Programme

Our full portfolio of mechanical engineering degrees, covering approximately 900 students. This includes BEng, MEng and MSc Mechanical Engineering and variants 'with a year in industry', 'with biomechanics' and 'with modern languages' etc.

New Approach

Integrative projects to facilitate capability-driven curricula.

About the programme

Our undergraduate courses comprise four elements:

- A sound underpinning of scientific and mathematical knowledge and analysis relevant to mechanical engineers.
- Substantial integrative projects which combine underpinning knowledge and professional skills to build capability in problem-solving and value creation.
- A structured spine of professional development building information literacy, communication, collaboration, self-awareness and leadership.
- Staged learning outcomes where students can recognise their own developmental journey, have increasing autonomy in determining and successfully pursuing personal goals and get maximum value from one of the most personalisable final year portfolios in the Russell Group.

Our taught postgraduate courses meet the specific needs of the cohorts that study with us. All students work in supported teamwork environments in the first semester to develop communities of learning, build research skills, and manifest our learning and teaching ethos.

Overview of the new approach

Our integrative projects are unique and valuable in that they leverage engineering knowledge and analytical skills for problem solving and value creation, liberated by a spine of professional capabilities. By scaffolding the development of professional capabilities and viewing them with the same rigour as technical skills, we empower students to synthesise these elements into professional engineering competence.

We selected this approach following discussions with stakeholders. Industrial consultation made clear that our graduates are outstanding in their technical and analytical skills, but limited in their ability to independently approach and get started on complex problems. Students told us that they wanted more 'tools' to graduate with – approaches and frameworks to take into the workplace.

We have been ambitious in pursuing the most meaningful assessment possible, facilitated by the project approach. In contrast to problem or project-based learning,

where a proliferation of relatively small scale problems or projects is used to ensure breadth of knowledge, large, sequenced projects running in parallel with engineering science blocks allow deeper integration that spans the curriculum. This has enabled us to move away from assessing within the arbitrary boundaries of modules that serve purely as a convenience in structuring teaching, but do not reflect the way knowledge is integrated in professional environments and directly impacts student wellbeing.

How the programme relates to other New Approaches facets

Beyond the integrative role of projects, our new curriculum has taken a new approach to engage industry in curriculum design. We target Year in Industry employers, who host penultimate year BEng and MEng students) as having important insight into the attributes of our cohorts.

They work firsthand with our students over the course of a year, and are often supervising students from other universities, so can offer considerable insights into the strengths and weaknesses of Sheffield undergraduates. Bringing these employers together gives us conversations which are much more fruitful than those we can have with our – albeit more senior – standing advisory board.

In parallel, we developed approaches to work with students as true collaborators [1]. Finding a gap in praxis related to students as ‘pedagogic consultants’ in curriculum design [2] we experimented and refined novel ways of working with students to maximise their contribution. This enabled them to engage on their own terms, and demonstrate through practical workshops and activities – led by them – what would be useful additions/changes within the curriculum. In short, to show, rather than tell us how they wanted to learn.

Leading and managing the change

In 2017 we changed our teaching leadership structure to have distinct director roles for operations, strategy and student experience. This freed up leadership capacity to embark on a meaningful curriculum review separate to the day-to-day running of the department. At the same time, our new learning and teaching strategy called for a programme-level approach to support learning and assessment profiles shift away from a modularised view of knowledge.

The newly-appointed Director of Learning & Teaching (Strategy) set up a diverse change team that involved curriculum leads, the practical teaching team, an enterprise education developer and students, who were recruited on a non-selective basis and paid for their time. An area was set-up on the departmental Google site to which all staff have access, to offer full transparency. In developing the new curricula, we seized opportunities to nurture and expand leadership capability across the department.

It has been important that this change be ethos-driven and insight-based. We have spent time checking assumptions with up-to-date data, reached for root-cause analysis in our deliberations, developed new mechanisms for industrial perspectives from people who know our students and created new ways of working with students in programme design. We recognise that innovation requires a positive attitude to failure and a stage-gate model coupled with wide consultation helps manage the risks.

Benefits of the new approach

We have identified three headline benefits:

- Assessment is transformed. The majority of programme assessment is much more authentic in and of itself, while making explicit links to underpinning knowledge to increase relevance and in turn self-motivation. Project work is substantial and integrated, supporting students to understand how the different parts of their curriculum relate to the practice of engineering.
- Better preparation for the graduation transition. Our new MEng final year offers reduced assessment loads for students – almost half, depending on electives chosen – and a (possibly unique) dedicated, supported, flexible curriculum space to help students prepare for graduation. It remains one of the most personalisable MEng final years in a research-intensive university.
- In-curriculum orientation and socialisation for overseas MSc students. All MSc students now have supported, compulsory teamwork in the first semester to help build learning communities and study skills and all work on a creative, fun practical project to introduce them to our makerspace facilities early in their programme.

Making the changes: learning points

Having developed our approach dynamically, we identify four key success factors in our programme-level innovation:

- Define a programme ethos: a dynamic, outward-facing statement of your programme’s purpose and values and the learning environment and outcomes that you aspire to create. This helps to bring the team together around a shared vision, and helps reach consensus in design decisions throughout the process. [3, 4]
 - Be careful of the assumptions that you bring to the task. Consult widely with stakeholders to uncover new opportunities and ideas, and do not overlook the significant value that students can bring to the design table. They offer unique expertise in being a student in the 21st century, which can only be accessed by involving them as design partners and pedagogic consultants. [1]
 - Think big: make the projects as big as possible so that they integrate as much knowledge as possible. Seeing what naturally fits within the projects can be a useful way of reflecting on your course content.
1. Avoid the temptation to think students will learn professional capabilities like teamworking simply by working in a team. Treat these skills as equally important to the academic content, scaffold their development and ensure that they are embedded within – rather than bolted onto – your curriculum. This ensures that students develop them in context and see their relevance.

Quotation from students

“The opportunity to develop professional skills with strong real world applicability is invaluable. The change in curriculum reflects a serious step in focusing and tailoring students professional development.” (Student A)

“The focus of the first year learning through the integrated projects would give students an exposure on how engineering works in the real world. Not only would they gain fundamentals of engineering through applications but would also be learning skills like team working and communication which will give them an edge when applying for internships and graduate roles in the future.” (Student B)

Statistics

- Year 4 and MScs launch in 2019/20, Year 1 launches in 2020/21 and Years 2 and 3 launch in 2021/22.
- 770 undergraduates and 100 postgraduates taught.
- The gender balance is 13% female, 87% male.
- Percentage in employment after six months – 89.2% (undergraduate).

References and footnotes

[1] Wood, G.C. & Gibbs, B. (2019b). Students as Partners in the Design and Practice of Engineering Education: Understanding and Enabling Development of Intellectual Abilities. In: Malik, M., Andrews, J., Clark, R., & Broadbent, R. (eds) *Realising Ambitions: 6th Annual Symposium of the UK&I Engineering Education Research Network*. Portsmouth: University of Portsmouth. Available at: <https://hefocus.raeng.org.uk/network-events/>

[2] Healey, M., Flint, A., and Harrington, K. (2014) *Engagement through Partnership: Students as Partners in Learning and Teaching in Higher Education*. York: The Higher Education Academy

[3] Wood, G. C. & Gibbs, B. (2019a) *Collaborative Vision Making for Programme-Level Design and Assessment*. Workshop at the Thirteenth Annual Learning and Teaching Conference, University of Sheffield, 8 January 2019 (resources available at: www.sheffield.ac.uk/staff/elevate/events/ltconf/archive)

[4] O'Neill, Geraldine (2015). Curriculum Design in Higher Education: Theory to Practice, 1st Edition. Chapter 3: Needs Analysis and Educational Philosophy. Dublin: UCD Learning & Teaching. Available at: www.ucd.ie/t4cms/UCDTLP0068.pdf