EVALUATING THE USE OF ITP METRICS IN SUPPORTING TEAMWORK

Tony Topping, Matt Murphy, Samuel Saunders

School of Engineering, University of Liverpool
The Centre for Innovation in Education, University of Liverpool

ABSTRACT

Learning to work within a team is an essential part of an engineering student's education. However, teamwork is not something that can be easily taught; students are often expected to develop a whole range of attributes and skills that come under the umbrella term 'teamwork' simply by participating in team activities. The School of Engineering, University of Liverpool is addressing recent student feedback that has revealed that students would benefit from, and be comforted by, more support in developing their interpersonal communication and teamwork skills. To enhance the provision of such support from instructors, the authors have deployed ITP metrics, a suite of online tools that has been developed by The Individual and Team Performance (ITP) Lab at the University of Calgary. In particular, this paper focuses on the use of; Team Contracts, a document that outlines expectations and team norms; Personality Assessment, a tool that builds awareness of personality factors and encourages reflection; Conflict Management Styles, a tool that explores personal styles and how they influence interactions with others and; Team Health Audit, a team diagnostic tool that aims to improve team performance. This paper describes how these tools were deployed and the associated learner benefits. In particular it explores further questions relating to; students' perceptions of using the tools; the barriers to engagement with the tools; and the alignment of these tools with different learning activities, at different levels of study. The paper finds that although the tools can support student development, activities that make use of the tools require more planning and development than initially assumed.

KEYWORDS

Teamwork, Skills Development, Reflective Practice, Standards 3, 5, 7

INTRODUCTION

Teamwork is a fundamental skill that graduate engineers are expected to master by the time they enter the engineering profession. This is reflected in the importance placed on this skill set by accrediting bodies, professional bodies, employers; and common benchmark statements such as the CDIO Syllabus. In the authors experience, most students entering university to study engineering have no significant experience in completing projects as part of a team and often lack the soft skills needed to successfully participate in team activities. However, training students to develop these soft skills can be difficult for instructors more

experienced in teaching technical disciplines (Andersson 2009) and who may be unfamiliar with employing teaching strategies outside of the traditional didactic methods that are often needed for soft skills development (Varkey et al. 2009).

Although soft skills now have a more prominent role in engineering syllabi, the development of soft skills in engineering education has been undermined by the lower status given to them over the previous decades (Male et al. 2009). This is reflected in the common 'hands-off' approach taken to teaching soft skills in engineering; put students into a team with only a rudimentary introduction to teamwork, give them a task and, assume that when conflicts arise students will deal with the issues themselves thus, learning from the experience (Usprech & Lam 2020). But this approach often fails as participation in team activities alone does not give students an understanding of effective behaviours and approaches; soft skills training requires proper support to ensure graduates are equipped to enter the engineering profession (Larson et al. 2016).

The literature from CDIO collaborators does offer examples of how to implement projects were students are required to work as a team and provides plenty of pedagogic reasoning for why implementing it can be of benefit (for example; Huet et al. (2008), Anderson (2009), Martins & Ferreira (2016) and Ling & Nengfu (2021)). However, there appears to be a scarcity in the literature that discusses how to support, encourage, and optimise student learning once a team activity has been introduced or what specific strategies instructors should implement when students begin to experience difficulties due to their inexperience. An example of this can be seen in a paper from Tedford et al. (2006) that details the experiences gained from running a team activity. A rationale for using project-based learning and team activities as a tool to improve soft skills is given, pedagogical approaches are documented and the paper presents both positive and negative feedback from students. However, no indication is given on how the instructor intended to address the negative feedback and support the students as they acquire the necessary skills to navigate the difficulties of teamwork.

MEng students graduating from the School of Engineering have been shown, through observation by academic supervisors, feedback from employers and from end of module feedback surveys, to possess the necessary skills to comfortably navigate professional level team environments. The pre-professional, real-world Capstone projects they work on in their final years of study have been shown to provide the necessary environment and support to enable them to develop the relevant skills (Topping & Murphy 2022). But teamwork issues can still arise in these Capstone projects and feedback has shown that the learning journey of a first year student getting to graduation still requires further support and guidance. This paper aims to explore how well established team activities can be further developed to offer students more support and guidance in developing interpersonal communication and teamwork skills.

TEAM ACTIVITIES AT THE SCHOOL OF ENGINEERING

All undergraduate programmes in the School of Engineering are built around a succession of teamwork experiences; increasing in duration and complexity, as students progress through the four year programme. Most of these activities are part of project-based courses, but students frequently work in groups on other tasks such as technical writing, ethics, and scientific problem solving. This study focusses primarily on design and design-build-test learning experiences. The figure below summarises the central spine of team activities in the MEng Mechanical & Aerospace programmes.

Figure 1. Primary Team Activities and Deployment of ITP Metrics tools

Historically, our approach to developing teamwork skills in our students has been one of immersion rather than formal instruction. In other words, students have been tasked with team based activities with little preparatory teaching of theory – instead learning through repeated, often painful experiences and guided reflection on those. At the heart of this approach is close support and supervision from academic staff as students complete their projects. Each student team has a 10 minute coaching and support session per week in Year 1, rising to 20 minutes in Year 2, and several hours close supervision in Year 3 & 4 Capstone projects. This approach has been optimised over 12 years and has been effective as proven by testimony from our graduates and their employers.

However in recent years formal evaluation feedback has revealed that students would like more formal instruction to prepare for team-work. They acknowledge the effectiveness of our existing approach, but they suggest they would benefit from more preparatory coaching and improved tools to support their reflective practice. To this end we developed a pilot project to explore the deployment and effectiveness of ITP Metrics.

PROPOSED INTERVENTION - ITP METRICS

ITP Metrics is an online platform that has been developed by The Individual and Team Performance (ITP) Lab at the University of Calgary. The platform can assess, track and report on individual and team metrics and provide diagnostic feedback and structured resources to support and improve individual and team performance (itpmetrics.com). The platform is browser based and free to use, providing assessments in five areas: Team Health, Peer Feedback, Conflict Management, Personality, and Leadership. An assessment requires a participant to complete a questionnaire that presents a series of statements which they respond to using five-point Likert scale answers. Questionnaires should take around 10-15 minutes to complete.

On completion, participants will be presented with a detailed personalised report, auto generated based on their answers, that places their results in a relevant context and provides insight into their competencies.

Two of the authors attended a workshop run by Dr Thomas O'Neill, founder of the ITP lab, at the recent international CDIO conference to investigate the potential of utilising the platform to support their efforts in improving students teamwork skills. As noted above, recent feedback from end of year surveys had demonstrated that new strategies were needed to support student learning and attendance of the workshop was aimed at exploring a potential solution. During the workshop the functionality of the ITP metrics tools were described and a demonstration given of the Conflict Management tool, with participants invited to complete short self-assessment and then discuss their subsequent results.

The study by Usprech & Lam (2020), although not conclusive, shows that there may be benefit to utilising these tools. Jamieson and Shaw (2018) report a preference for using ITP over a similar platform (CATME) and report that it can support overall team development with functionality that allows students to reflect on their own strengths and weaknesses which can, in turn, inform steps to modify behaviour. O'Neill et al. (2017) conclude that using the tools to build team dynamics can improve student achievement levels and that a moderate to high level of usability and utility were reported by students; a key consideration when implementing any new software tools. This is echoed by LeNoble and Roberts (2021) who recommend the use of the tools due to the ease with which they can be distributed; the utility of the automated reports and; that the tools are currently free to use.

Based on the experience gained from the workshop, a brief literature review, and a subsequent reflection on how ITP Metrics could align with the teaching needs of the authors, the platform was chosen as the tool to be used in the pilot intervention detailed in this study. A summary of considerations is given below.

- The platform is free to use.
- The ease with which ITP Metrics could be deployed within existing activities and its flexibility to be deployed regardless of the discipline specific content of a given activity.
- The reflective nature of the assessments encourages students to gain; self awareness; an awareness of their teammates' traits and competencies and; an awareness of how to mitigate potential conflict caused by the differences in individual approaches and the interaction between different personal traits.
- The auto-generated reports contain detailed information on how to interpret the results and how different personal traits can deployed in different situations. Reports also contain exercises that aim to give students the opportunity to work on areas that they feel require improvement.
- The platform offers further support and resources to help instructors get the most out of the assessment process, including de-brief lectures and activities.

APPROCHES & RESULTS

Of particular interest to the authors are the two questions; *"Exactly where and when should each tool be deployed to ensure they are used at an appropriate time within a programme and by students with an appropriate level of experience?"* and; "*How do we properly structure learning exercises around the use of these tools to maximise learner benefit?"*

As detailed above, the tools are assumed to offer an overall benefit to supporting teamwork, but understanding how the tools deployment could be optimised would be of benefit. To begin to answer these questions, the School of Engineering piloted the use of ITP Metrics in the academic year 2022-23, using four of the platform's tools. The aim was to gather initial data to inform and develop future use of ITP Metrics. Prior to deployment off the tools, a mapping exercise was carried out to attempt to identify where each tool should be deployed. Figure 1 shows the outcome of this mapping exercise, with more a detailed rationale given in the sections below. After the students had used the tools they were invited to complete a survey consisting of a mix of Likert scale and open ended questions. The survey invitation was sent to 536 students and had a response rate of 12% (69 students).

ITP Metrics Tool: Team Contracts

The purpose of a team contract is to outline the standard operating practices and team norms for the team and individual members. Contracts were used with students in their first and second years of study; these students have the least experience with working in a team and so explicitly outlining teamwork expectations would be of most benefit. ITP Metrics provides a template contract and recommends an exercise to encourage students to develop their own contracts. However, given students lack of experience it was decided that they would receive a fully formed contract to read and sign. This contract was developed using ITP Metrics' template as a start point with changes made based on instructors experience of common issues and the input of a fourth year engineering student working as an educational development intern. Students were introduced to the contracts and given a rationale for their use during the first session of each module. They were then instructed to discuss the contracts as a team and decide on preferred modes of communication and preferred days and times for team meetings.

The contract exercises formed part of a timetabled, in-person sessions meaning engagement with the activity was high; all members from all groups signed a contract. Initial reactions to the activity were 50.7% 'Positive', 44.9% 'Neutral' and 4.3% 'Negative. All respondents either agreed or strongly agreed that the contract helped to set expectations, however when asked, on a scale of 1-10, how conscious they were of the presence of the contract after signing it, 59% of students rated their level of consciousness 5 or below. The survey data shows that all agree that a document detailing expectations is useful but in the current format it was rarely used and easily forgotten about; 85% of students reported that they or a team mate did not refer to the contract again during the course of the project. Anecdotal and casual conversations with the students after they had completed the contract exercise revealed several major themes:

- Although they acknowledged the need for clear expectations to be documented, they were aware of the fact that the contract was consciously artificial and therefore did not carry much weight in terms of helping team-members to remember their responsibilities.
- That the contract was unlikely to make much of a difference in terms of team-members' commitment to the team. In essence, it was felt that if a team member had decided to not participate already, then the contract was not likely to change their mind.
- That the prime motivator for completing the group tasks was the prospect of completing the programme itself and being awarded marks for the work.
- That the social contract that exists between team members was more powerful than the formal one – in some cases, students had immediately forgotten they had signed a formal contract.
- That the contract was perhaps unlikely to be used in any kind of conflict situation.

There was also an overarching sense across a large group of students that a contract was simply heavy handed and possibly unnecessary. A response in the survey likened using a contract to resolve conflict to "*telling your parent when someone hits you"* adding "*it's kind of cringe [embarrassing/awkward] and it's not the first thing people will resort to".* It appears that the contract would benefit from a change in format; instead of something formal that requires signatures it should be a document that lists individual expectations and team norms. A number of students noted in the survey that they would like to see *"more specifics on what each person should achieve".* A reminder of the document before each assignment may be useful along with a requirement that students amend it to clearly document how the workload will be allocated, perhaps a small percentage of the assignment grade could be given to this work allocation exercise. Five students mentioned that there should be "*punishment"* or "*consequences"* for not adhering to the contract. Although outside the scope of this study, it is interesting to note that perceived fairness of teamwork appears to be a factor in team conflict. If there is an expectation that instructors should be doing more to penalise poor performance, perhaps this should be considered when designing strategies to support students in teamwork activities.

ITP Metrics Tool: Personality Assessment

This assessment produces a report that outlines a participant's level on five factors of personality based on the responses to the completed questionnaire. The personalised report received upon completion describes how these personality traits can relate to team interactions and experiences in teamwork. The assessment was used with students in their first and second years of study as a strategy to help them gain experience with self-reflection exercises and to introduce them to the concept that understanding their own personality could help them better understand how they function within a team. The assessment was deployed in the fourth week of each module and was introduced and explained during a lecture with students instructed to complete it over the following week. During the lecture they were given some prompt questions to help them self-reflect on the outcomes along with some prompt questions to help them discuss and reflet the outcomes with teammates. This was an optional assessment with no credit value and no formal submission required.

Engagement for this activity was as follows: ENGG111 - 60.4%; AERO220 - 57.4% and; MECH212 - 63.5%. This is less that the contract activity, likely because students were instructed to complete the assessment in their own time. Initial reactions to the activity were 51.5% 'Positive', 45.6% 'Neutral' and 2.9% 'Negative. When asked if the personality assessment had helped them to reflect on their skills as a team worker, 56.9% of students said 'Yes', 26.2% said 'No', with 16.9% 'Not sure'. The open ended questions give a sense that whilst students found the assessment interesting, they did not make the link as to why it was relevant. Overall 13.2% found the assessment 'Very useful', 35.3% found it 'Somewhat useful', 35.3% were 'Neutral', and 16.2% found it a 'Waste of time'. Although some students found the results of the assessment interesting and two thirds of the class said that it had helped them to reflect on their own skills, it's not immediately clear if this assessment had any significant impact on improving group work skills: less than half of respondents found it useful. Students were instructed to discuss the results with team mates (if comfortable to do so) but this didn't happen and it is unclear at what level individuals carried out self reflection. 73.8% of students said that they did not discuss the results with team mates. When asked to choose (multi answer) any reason for not discussing, 48.9% chose 'I forgot to discuss the results', 42.6% choose 'I thought it would not help' and 17% said that they 'felt uncomfortable discussing the results'.

Of the students who did discuss with teammates, when asked to choose (multi answer) any outcome of discussing, 52.9% chose 'it helped overall', 29.4% chose 'I understood more about teammates', 17.6% chose 'I worked to accommodate different personalities' but 29.4% said that it 'had no effect'. While the authors maintain that there could be some benefit to doing this activity, the current design of the activity did not work. It would appear that this activity requires more guidance and facilitation from instructors; to encourage students to reflect and discuss more thoroughly; and to more clearly place the activity in the relevant context.

ITP Metrics Tool: Conflict Management

This activity produces a report that can help to build awareness and create discussion about personal styles of conflict management. The associated questionnaire requires students to answer questions based how they would typically handle conflict in a professional setting. Used as a self-reflection exercise to improve team functions, students can gain greater awareness about scenarios in which each style would be the most effective. The assessment was used with students in their second, third and fourth years of study and who will have had some experience of teamwork activities. The assessment was deployed towards the end of the first semester of a module to ensure students would have had chance to experience teamwork and any related issues, giving them chance to provide more accurate answers to the questionnaire. The assessment was introduced and explained during a lecture with students asked to complete it anytime during the following week. During the lecture they were given some prompt questions to help them self-reflect on the outcomes along with some prompts questions to help them discuss and reflet the outcomes with teammates. Third and fourth year students were encouraged to complete a SMART action plan, based on their results, to help guide and track future progress. This was an optional assessment with no credit value and no formal submission required.

Engagement for this activity was as follows: AERO220 – 15.5%; MECH212 – 15.3%; AERO321 - 25.3%; AERO401 - 38.1%. Initial reactions to the activity were 37% 'Positive', 63% 'Neutral'. Engagement and positive reactions to this activity are lower in comparison to the two earlier activities. This could be due to students feeling fatigue in completing these activities or because the personality assessment showed no immediate benefit; students may have assumed that this would be the case with this assessment too. One student reported "*[being] fortunate with my team so not had any conflicts to resolve";* it could also be possible that the assessment was deployed too early i.e. no conflicts had occurred and therefore students didn't see the need for activity at that time. When asked about their awareness of how they react in conflict situations, 23.1% of respondents reported 'Full awareness', 65.4% reported some awareness and 11.5% reported no awareness. When asked was the activity helpful in reflecting on how they dealt with professional conflict, 59.1% of respondents said 'Yes', 13.6% said 'No' and 27.3% weren't sure. When asked if the report was useful or insightful, 81.8% said either 'Yes' (13.6%) or 'Somewhat' (68.2%). However, 80% of respondents reported that they did not feel the need to think back to the assessment after completing it and 87% of respondents reported that they did not discuss the assessment with teammates, with 60% citing that they 'forgot about it' and 35% that they 'didn't think it would be useful'. Whilst some of the survey data suggests that there is potential benefit, the current design of the activity did not fully engage students; they failed to discuss the results with teammates and in most cases just forgot about the assessment results. As with the findings from the personality assessment, it would appear that this activity requires more guidance and facilitation from instructors. One student suggested roleplay as way to facilitate discussion -*"Maybe create fake conflicts to encourage the groups to solve them using the techniques discussed".*

It should also be noted that having students complete and discuss the assessment in their own time could be an issue; one student reported that *"If left to do [the activity] in our own time, and it isn't scheduled in the timetable, the likelihood for myself is that I just forget given I prioritise other tasks*" with another suggesting that "*[activities should be] timetabled in to make people do it rather than a 'spare time' thing."*

ITP Metrics Tool: Team Health Audit

This assessment allows students to assess the health of their team using the 'Team CARE' model, with the aim of ensuring a well functioning team. The associated questionnaire is completed by all members of a team with the results collated into a single team report. The report is generated to provide students with an idea of how they can direct their future actions toward improving teamwork. The assessment was used with Capstone students in their third and fourth years of study and who will have the most experience with team-based activities. These students, particularly the fourth year students, are usually well equipped to operate within a team but would still benefit form the fine tuning of team operations that this assessment can provide. The students were asked to discuss the results of the assessment and produce a SMART action plan identifying areas for improvement. The assessment was deployed at the end of semester one (both in year 3 and 4) with the discussion and action plan taking place at start of the semester 2, giving time for improvements to be made by the end of the year.

The engagement with this activity was as follows: MECH327 – 0%; MECH431 – 21 .3%; AERO321 – 0%; AERO420 – 11.9%.Initial reactions to the activity were 26.7% 'Positive' and 73.3% 'Neutral'. These results are much lower than the other activities and therefore no insight has been gained regarding this activity. Due to the small number of students who completed the activity and the subsequent smaller number of students completing the survey, no further results are presented here. However, some insight has been gained into the process by which these activities are deployed. These modules are project based and therefore rarely require students to attend lectures; it was difficult to organise a time to get all students together to introduce the activity and give a rationale for engaging. Instead, a short video was recorded and uploaded to the virtual learning environment with students then receiving email instructions to watch the video and complete the assessment. It is clear that this type of approach does not work and that all efforts should be made to gain student buy-in for these activities. It should also be noted that, whilst the rationale was sound for the timings of deploying this activity, in practice, it clashed with a busy assessment period for these students, offering another explanation for the poor engagement.

CONCLUSIONS

When this study was initial conceived, the intention was to pilot ITP Metrics in as many modules as possible, to gain as much data as possible. However, this approach has introduced limitations to the study. Many of the modules where ITP Metrics was deployed were not taught by the authors; whilst the module coordinators were accommodating and allowed the use of ITP Metrics in their modules, it was agreed that the authors would take all responsibility for deployment. This led to difficulties with the logistics of introducing, facilitating and monitoring the activities across all the modules and then reminding students to participate. This in turn has led to a lower engagement than expected, with some results based on a small proportion of the class. As the authors continue to develop the use of these tools, less modules will be included in the development phase, allowing more time to be spent on optimising the techniques required to deliver these activities.

It had been assumed that students would freely participate in these activities as their engagement would result in positive outcomes for them. This assumption was wrong. The results show a clear difference in engagement between the activity done in class and the activities done in students own time. This indicates that the biggest factor driving engagement is whether class time was allocated or not. It also indicates that students perhaps don't see a direct link between engagement with the activity and an improvement in their teamwork experiences. It would seem that students require more careful facilitation to discuss and reflect on their results to be able to understand how these tools can be of benefit. The information provided within the personised reports was assumed to be sufficient enough to allow for minimal intervention and facilitation from instructors but these results indicate this assumption to be wrong. The timing of the activities also appears to have impact on engagement; if they are deployed too early in a module students may not find them relevant and forget about them by the time they are required. It would also appear students would benefit form periodic reminders that the tools are available. The strategy by which the authors introduced these activities to students should also be noted; students were informed that the use of ITP Metrics was experimental and this perhaps may have discouraged some students from engaging. These initial results show that ITP Metrics can be a useful tool in developing student's teamwork skills however, work is required to properly integrate them into a programme. The authors will continue to use ITP Metrics, further developing and refining deployment approaches.

ACKNOWLEDGEMENTS

The authors would like to thank Jack Scott, a MEng student who worked as summer intern contributing to the development the new activities.

FINANCIAL SUPPORT ACKNOLEDGEMENTS

The authors received no financial support for this work and have no affiliation with the ITP Metrics Lab or their employees.

REFERENCES

Andersson, N. (2009) Teaching Interpersonal Skills – The Concept of Social Risk Analysis, *Proceedings of the 5th International CDIO Conference, Singapore Polytechnic, Singapore*

Huet, G., Sanschagrin, B., Gagnon, M., Spooner, D., Vadean, A. & Camarero, R. (2008). The Assessment of Student Teamwork to Promote CDIO Learning Objectives*, Proceedings of the 4th International CDIO Conference,*

Jamieson, M. V., & Shaw, J. M. (2018, June), CATME or ITP Metrics? Which One Should I Use for Design Team Development and Assessment? *Paper presented at 2018 ASEE Annual Conference & Exposition , Salt Lake City, Utah. 10.18260/1-2—30179*

Larson, N., O'Neill, T., Hoffart, G., Eggermont, M., Smith, J., & Rosehart, W. (2016) An Evidence-based Approach to Assessing and Developing Teamwork Skills, *Proceedings of the 12th International CDIO Conference*

LeNoble, C., & Roberts, D. (2020). At the frontier of teaching and practice: Relevant issues for non-traditional undergraduate I-O psychology. *Industrial and Organizational Psychology, 13(4), 487-491*. doi:10.1017/iop.2020.82

Ling, S. & Nengfu, T. (2021) Develpoing and Assessing Teamwork with Enhanced Team-based Learning Approach, *Proceedings of the 17th CDIO International Conference*

Male, S.A., Bush, M.B., & Murray, K. (2009) Think engineer, think male?, *European Journal of Engineering Education, 34:5, 455-464*, DOI: 10.1080/03043790903137759

Martins, F. & Ferreira, E. (2016). Integrating CDIO Skills by Teamwork in a School of Engineering – ISEP, *Proceedings of the 12th International CDIO Conference*

O'Neill, T.A., Deacon, A., Gibbard, K., Larson, N., Hoffart, G., Smith J. & Donia, B.L.M. (2018) Team dynamics feedback for post-secondary student learning teams, *Assessment & Evaluation in Higher Education, 43:4, 571-585*, DOI: 10.1080/02602938.2017.1380161

Tedford, D., Seidel, R. & Islam, M. (2006). Project and Team Based Learning - an Integrated Approach, *Proceedings of the 2nd International CDIO Conference and Collaborators' Meeting,*

Topping, T. & Murphy, M. (2022) Characterisation of Effective Delivery and Supervision of Capstone Projects, *Proceedings of the 18th International CDIO Conference,*

Varkey P, Gupta P, Arnold JJ, Torsher LC. (2009) An innovative team collaboration assessment tool for a quality improvement curriculum, *Am J Med Qual Jan-Feb;24(1):6-11.*doi: 10.1177/1062860608326420.

Usprech, J. & Lam, G. (2020) Self-awareness and empathy as tools to mitigate conflict, promote wellness, and enhance performance in a third-year engineering design course. *Proceedings of the Canadian Engineering Education Association Conference, Montreal, QC, Canada.*

BIOGRAPHICAL INFORMATION

Tony Topping is a Learning Technologist in the School of Engineering and a Master of Arts candidate in Academic Practice, both at the University of Liverpool. He has a technical background, having worked as Teaching and Research Technician for 15 years, where he developed and delivered authentic learning experiences. His current work focuses on blending pedagogic and technical knowledge; and the use of technology to enhance the teaching activities of the school.

Matt Murphy is a Senior Lecturer in Engineering Design and Director of Education at School of Engineering, University of Liverpool, UK. He is a metallurgist by background with a PhD and 10-year technical research career in the additive manufacture (3D printing) of metals. For the last 14 years Matt has worked primarily on learning & teaching and has held several leadership positions in the School of Engineering, with special responsibility for curricular and pedagogic reform. Matt teaches a range of courses in materials science & manufacturing, but most enjoys leading the group design project modules. He establishes and supervises a broad range of student projects in fields such as renewable energy, urban farming, sustainable transport; veterinary healthcare; circular economy; and the local recycling of thermoplastics. In recent years Matt has focused on developing authentic learning and assessment experiences that seek to replicate industrial practice within taught programmes.

Samuel Saunders is an Educational Developer in the Centre for Innovation in Education (CIE) at the University of Liverpool. He has worked in higher education since 2015, and has a background in academic, pedagogic and curriculum development. Sam is particularly interested in assessment and feedback, programme and learning design, research-led/research-informed teaching, and decolonising pedagogy/assessment. Sam also holds a PhD in nineteenth-century literature and culture, and has published widely in this area.

Corresponding author

Tony Topping
School of Engineering
University of Liverpool
Liverpool, L69 3GH
United Kingdom
topping@liverpool.ac.uk