A Problem Shared is a Problem Halved: Benefits of Collaborative Online Engineering L&T Content Development

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CONTEXT Three academics from three separate Engineering schools (Chemical, Civil and Mechanical) at a large, research-intensive public university, identified an opportunity to collaborate with an Engineering student partner, Educational Developer and Learning Analytics Manager on the design and development of blended learning resources. The collaboration focused on the development of a question bank that could be shared across the three schools to support teaching in large cohorts. This paper explores the different perspectives of all stakeholders in the project, the challenges experienced and how the team resolved them.

PURPOSE Student feedback across the three schools revealed an opportunity to provide more individualised support resources for students in large cohorts. The team considered the use of comprehensive question bank resources to meet this need. An important consideration and challenge for the team was to design feedback mechanisms that enabled students to identify and understand their misconceptions with complex fluid engineering concepts (embedded feedback), and/or receive a general solution approach to help them retry the same question.

APPROACH After a review of existing practice and a mapping of content taught in the different courses, the team reviewed several commercial off-the-shelf question bank solutions. Many of the commercial products explored were subscription-based, and had customization, content and feedback limitations that reduced the effectiveness and sustainability of the resource. Despite the effort required for the development of a new question bank, this afforded both flexibility and control of the final product.

RESULTS Based on our experience and lessons learnt, we proposed a framework for cross-school collaborative development of blended learning resources, including team composition, distribution of tasks, and tools and strategies for rapid development work, digital content management and sharing. Benefits of the project included the online resources enabling monetary resources to be reallocated to an industry-relevant design activity, thus enabling a better integration of theory and practice in the Chemical Engineering Fluid Mechanics courses. The project also identified an opportunity for shared physical lab resources between the Civil and Mechanical schools.

CONCLUSIONS Good strategies in collaborative online content development can lead to many benefits and enable the integration of theory and practice in Fluid Mechanics courses, benefiting the students as well as making the feedback to students more effective.

KEYWORDS Blended learning, question bank, cross-functional teams

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Introduction

The past decade has seen several changes in engineering education (McKenna, Yalvac, & Light, 2009), including a focus on curriculum redesign (Crawley, Malmqvist, Östlund, Brodeur & Edström, 2014), students' skills development (Shuman, Besterfield-Sacre & McGourty, 2005; Walther & Radcliffe, 2007), assessment methods (Olds, Moskal & Miller, 2005) and modes of teaching (Bourne, Harris & Mayadas, 2005; Ford, Vigentini, Vulic, Chitsaz & Prusty, 2016; Mills & Treagust, 2003; Prince, 2004). These have largely been possible thanks to an increase in funding supporting innovative practice and growing pressure from the industry on universities to provide engineers that "build things that serve society" (Crawley et al., 2014) and "create the world that never was" (Von Kármán, 1994).

In a similar vein, a project was initiated by the Engineering Head of Schools and Deputy Dean of Education at a large public research-intensive university in Sydney to support academics moving their courses to blended delivery mode. Nine large courses, taught by multiple schools in the faculty of Engineering, were initially selected for re-development. Small teams of three academics were formed for seven of these courses because they covered similar content and lent themselves for potential efficiencies across the schools. This approach is not dissimilar to many other examples of integration (Evans, 1995; Froyd & Ohland, 2005). However, the focus, partly directed by institutional strategy (UNSW, 2025), was on a blended approach to learning design (Garrison & Kanuka, 2004; Porter, Graham, Spring & Welch, 2014).

Although there are several accounts of the outcomes of the innovations implemented, there are only few accounts reflecting on the process and achievements of a collaborative redevelopment project. This paper aims to fill this gap and examines the engineering design process involved in the teaching of *fluids mechanics* concepts across chemical, civil and mechanical engineering schools at the university. By examining the detailed account of one team in the project, which included three engineering academics, an undergraduate engineering student as partner, and an educational developer, we provided an insightful overview of the redevelopment process.

The Context

The project demonstrates an example of the collaboration between staff with disciplinary expertise, learning design and educational design and development skills, and partnership with students, to enhance the learning experience for students in both blended and online contexts. The teams included academic staff, educational developers, media specialists and a student partner. The Schools and Faculty of Engineering provided funding to support the redesign and development work; $15,000 was also allocated to support the employment of students as partners. Each project had a timeline of three months. The project deliverables for each course included the redesign of courses for a blended delivery, the development of a range of online learning resources (including online practice exercises, online assessments, quizzes, question banks, adaptive tutorials, lab activities, videos and digital graphics), workshops and a pilot of the Active Learning Platform (ALP - based on Echo360) to facilitate new approaches to lecturing. A significant outcome of the project was the collaboration between academics from different schools that led to the establishment of common understanding regarding the delivery of courses with similar content.

Before the project: problems and the individual contexts

Chemical Engineering Academic

According to ML, the project provided a potential opportunity to explore different teaching methods. The course had been predominantly taught in the same way over the last twenty years. Further, the school budgets have not been substantial enough to enable the exploration of different teaching methods. This project created an opportunity to re-think the approach. For this academic, the project could potentially promote the development of creative engineers that see beyond worked examples and can transfer their knowledge and skills to cope with unexpected situations. In addition, the project initiation offered the opportunity to foster capacity building, and focus on course continuous improvement and shared team effort, contributing to better quality resources. Capacity building would involve the opportunity to train school research assistants in the design and development of course resources, and the dissemination of these skills and experiences throughout the school. Continuous improvement would take the form of evaluating and improving the resources each semester through both qualitative and quantitative measures. It was also anticipated that the team effort in creating shared course resources would produce better quality resources than those produced individually. An added benefit of a collaborative project team was the peer support network that this would enable. For students, it was hoped that the outcomes of the project would enable confidence building and mastery through a dialogic construction of knowledge.

Civil Engineering Academic

SF saw Fluid Mechanics as one of the most challenging courses for his second-year civil engineering students. It is a large course with 550 students and for many students the course is their first contact with the water engineering side of civil engineering. SF was interested in trying something new to improve student learning of key water engineering concepts. This project could ultimately motivate more students to get excited about water engineering. The project also presented an opportunity to connect with other academics who teach Fluid Mechanics and learn from their experiences, build synergies and cross-pollinate ideas. The academic wanted to provide students with resources where they had an opportunity to practice as much as they liked, whilst at the same time providing them with feedback. Allowing students opportunities to practice basic concepts was essential for students to fully understand basic Fluid Mechanics concepts. Common feedback from students was that they wanted to have more examples, more practice and more feedback. This could all be combined into the one project. It was anticipated that satisfied students might be more motivated to contribute actively to learning and to their classes in general. In the long run this academic hoped these students might become better engineers and problem solvers.

Mechanical Engineering Academic

For SC, the project could potentially enable an optimal and seamless integration of face-to-face teaching with digital education. It was hoped that this combination could provide the delivery of a distinctive educational experience for his students by empowering them to become the best that they can be. The project was timely in that large cohorts and physical resource limitations meant the school was replacing face-to-face tutorials with online tutorials. The project could add value to the online tutorials. The project also provided an opportunity for the academic to work with other colleagues to design, experiment and integrate the best available educational technologies into their Fluid Mechanics courses. It was anticipated that blending face-to-face teaching with digital education provides students with greater flexibility to personalize their educational experience and life-study balance. The project could potentially enable a considered integration of online technology to improve student learning through innovative use of online tutorials, question banks and online forums.

The Student View

JJ is an undergraduate who sought an opportunity to contribute to the development of the Fluid Mechanics course that he had taken during his studies. His first-hand experience meant that he could make a major contribution in supporting other students in resolving the issues he had already faced. The Fluid Mechanics courses, amongst other courses in second year, were particularly challenging, as they were a large step up in content compared to first year courses, which are generic across all Engineering streams. In addition, these courses laid the foundational knowledge for the rest of the coursework, and difficulties in these courses can lead to a poor understanding of material later in the degree program. It is therefore important to improve the learning outcomes of these subjects so that students develop into confident and capable engineers. JJ wanted to develop resources to allow students to practice engineering problems at their own pace in a structured manner. Ideally, the resources would be able to present themselves to the students at the right moment for them; then, as they built confidence, it would present them with harder problems, introducing new concepts and building on existing concepts. At each stage the student would be provided with feedback to identify particular problems that they were having trouble with to enable them to progress with the material and not feel overwhelmed. The result (not necessarily from this project alone, but from their learnings overall throughout their coursework) would be to have engineering students who can make justified assumptions, apply sound logic and reasoning, and apply engineering equations and concepts to complex problems, particularly those which have no algebraic solution.

The Educational Developer

JV has the challenging yet rewarding role of working with academics in the analysis, design, development, delivery and evaluation of their courses. This project was quite unique in that it brought three separate engineering school academics together (who had never previously met) to collaborate on one project. The project would be challenging in that team consensus would be needed in deciding on the focus of the project, whilst ensuring that it was possible to accomplish the deliverables within three months. The educational developer was motivated for the project to succeed and understood that his role was to ensure the team developed a project they could take ownership of. He understood that this would provide the best opportunity for their project to be sustainable over time. His role would be to act as a conduit for the team, linking them to internal resources where required, providing pedagogical and project coordination support. The project presented an opportunity to trial a new concept in the university called 'students as partners,' where funding would be provided to employ a student to be part of the project team. This would provide a valuable student perspective of the project, and avoid what the developer had coined 'ivory tower design,' where resources are developed without the input of the end user. The developer was interested in the insight that a student would provide to the project and whether this could be trialled in other projects.

The shared problem

After facilitating a discussion about similarities and differences of their courses, the team created a blueprint of topics and concepts that showed an overlap of at least 80% of concepts in Fluid Mechanics across the three curricula. The academics shared similar experiences related to feedback and requests from students to increase the formative elements of each course, as well as the example questions in their courses, and to provide continuous and detailed feedback on how students were going in their classes. The academics reached consensus very early in the project that support resources in the form of a question bank could potentially add value to support student learning. Given the overlap of content, all could contribute to writing questions to be shared across the three courses; however, it was imperative that the remaining 20% of content could be controlled by each academic.

The Educational Developer supported the team by acting as a conduit to connect the team members to support personnel during the project. This involved linking the team to library liaison officers to discuss copyright, assessment experts, staff with Moodle STACK question type experience and data analytics personnel. He was able to highlight strengths and weaknesses of various question bank options as well as the technical requirements to make the implementation possible. The team also spent time working out how to keep the project sustainable, for example, if future updates were required for questions in the question bank, how could they ensure they could be made by all team members easily and at no cost. One decision that enabled this was the use of Moodle learning management system (LMS), which allowed the academics to have total control of all questions in the question bank, as well as future updates of these resources. The disadvantage of this approach, however (as compared to using a commercial off-the-shelf question bank), was the initial outlay of time taken to design and develop the questions. The question bank was intended to be developed with a mix of both Moodle quiz questions for simple questions, and Moodle STACK questions for questions requiring more complex mathematical expressions. Feedback was an important component of the design of the questions. The key advantage of feedback is that students understand where they went wrong (embedded feedback), and/or that they receive a general solution approach that will help them to retry the same question. The design and development of questions in the question bank involved the input of all the academics and student partner. The student also coordinated student testing of questions in the question bank with fellow students in order to gain valuable feedback to improve the questions. All images were designed using readily available and easy to use software (PowerPoint) to ensure ease of future updates.

Implementation

Chemical Engineering

With the key aims being to encourage students to keep up with the concepts covered in their lectures, to prepare students for their tutorials, and to have a tool to identify potential knowledge and skill gaps, the question bank was implemented as weekly short (<1 h) summative quizzes worth 1-2% each (Table 1). Each quiz was open book and unmonitored, with students allowed to attempt each quiz multiple times. The participation was high for all seven quizzes (>90% of cohort).

Table 1: Implementation and usage statistics for Chemical Engineering

Implementation	Description	Usage Statistics
Marked Quiz 01	Fluid Properties and Physical Quantities	608 by 209 users (97.7%)
Marked Quiz 02	Rheology of Fluids and Semi-Solids	439 by 207 users (96.7%)
Marked Quiz 03	Fluid Statics	918 by 210 users (98.1%)
Marked Quiz 04	Fluid Dynamics	609 by 204 users (95.3%)
Marked Quiz 05	Fluid Handling – Flow in Pipes	242 by 203 users (94.9%)
Marked Quiz 06	Fluid Handling – Pump and Pumping	1477 by 203 users (94.9%)
Marked Quiz 07	Dimensional Analysis and Similitude	1352 by 208 users (97.2%)
Marked Quiz 08	Differential Analysis of Fluid Motion	685 by 202 users (94.4%)

There were several observations on the impact of the question bank. These related to a significant reduction in support traditionally requested by students, and an increase in the quality and complexity of student queries. Prior to the question bank being implemented, the academic would receive multiple emails from students asking questions around basic concepts covered in the course. The question bank unexpectedly reduced email support to nearly zero. Another observation centred on an increase in the quality and complexity of questions in the online course forum, lectures and tutorials. This signified that the question bank potentially helped students to identify their knowledge and skill gaps. ML noted several gaps and areas for improvement with the question bank. The question bank was noted as being not enough by itself to scaffold students to understand more complex questions, or instil confidence and strategies to tackle the course material. The first iteration of the question bank also had a few errors that frustrated students. A pilot using a third-party question bank was also trialled at the same time within the course; however it was observed that students engaged more with the Moodle question bank than with the third-party question bank.

Civil Engineering

The online question bank was implemented into 20 separate quizzes (Table 2) to allow students to practice questions as often as they want without any marks. The quizzes became available to students in parallel to the lecture topics. All quizzes contained between 10 and 40 questions of varying difficulty to allow students to practice. A separate Moodle Discussion Forum was set up, where students could post questions regarding practice questions, clarify feedback or alert the academic to potential problems with a question (such as missing words or variables, checking of correct answers, etc.). The Forum was managed by a Postdoctoral Teaching Assistant. One valuable lesson learnt during the trial of the question banks was the importance of quickly fixing any issues with quiz questions (which did not always occur) in order to avoid potential student frustration with incorrect questions. Overall, the quiz appeared well received by students and it was a good practice for the two marked online quizzes in the course (i.e. students new to the style and working of quiz questions). At the start of the course there was more participation (>50% of cohort), and this declined throughout the course to less than 20% of the cohort. Initial observation was that there were potentially too many questions in the quizzes, and once the course assessments were completed, students did not attempt the quizzes as often. This is supported by the 100% participation score in the two marked quizzes that took place in Weeks 4 and 7. Once the marked online quizzes were finished, student participation dropped (see drop from Practice Quiz 11 in Table 2). A future idea is to have weekly quizzes with small marks assigned to them to encourage continuous student learning and practicing. Formal student feedback scores revealed positive feedback for the online resources in the course, including the question bank (5.12 agreement and 94.8% satisfaction) and the overall course (4.96 agreement and 93.3% satisfaction).

Table 2: Implementation and usage statistics for Civil Engineering

Implementation	Description	Usage Statistics
Forum	Forum for practice questions	7347 by 263 users (48.7%)
Practice Quiz 01	Dimensions	8352 by 397 users (73.5%)
Practice Quiz 02	Fluid properties - basic understanding	17882 by 343 users (63.5%)
Practice Quiz 03	Fluid properties - numerical	8962 by 259 users (48.0%)
Practice Quiz 04	Hydrostatics - Manometer	16211 by 271 users (50.2%)
Practice Quiz 05	Hydrostatics - Forces submerged bodies	14121 by 257 users (47.6%)
Practice Quiz 06	Hydrostatics - Miscellaneous	3899 by 163 users (30.2%)
Practice Quiz 07	Kinematics of Fluid Motion	2411 by 158 users (29.3%)
Practice Quiz 08	Continuity	5272 by 183 users (33.9%)
Practice Quiz 09	Bernoulli equation - basic examples	4750 by 146 users (27.0%)
Practice Quiz 10	Bernoulli equation - applications	3744 by 119 users (22.0%)
Practice Quiz 11	Momentum equations	4145 by 134 user (24.8%)
Practice Quiz 12	Pipe flow - Basic understanding	2111 by 91 users (16.9%)
Practice Quiz 13	Pipe flow - Friction losses	2552 by 86 users (15.9%)
Practice Quiz 14	Pipe flow - Local losses	2254 by 63 users (11.7%)
Practice Quiz 15	Pipe flow - applications	1426 by 73 users (13.5%)
Practice Quiz 16	Dimensional Analysis - basics	2714 by 80 users (14.8%)
Practice Quiz 17	Dimensional Analysis - applications	1305 by 75 users (13.9%)
Practice Quiz 18	Physical Modelling	1690 by 75 users (13.9%)
Practice Quiz 19	Boundary layer / Friction force	1082 by 83 users (15.4%)
Practice Quiz 20	Drag force	2432 by 98 users (18.1%)
Marked Quiz 1	Topics from Practice Quizzes 01 - 08 (5% of course marks)	21757 by 550 users (100%)
Marked Quiz 2	Topics from Practice Quizzes 09 - 11 (5% of course marks)	22391 by 544 users (100%)

This satisfaction was much higher compared to previous years and was above the school average. One student mentioned in their feedback: “The online Moodle practice quizzes are wonderful and super helpful and I would like to thank you for having it prepared!” Other students were less satisfied, with one student complaining, “The online question bank was overwhelming with the number of questions, and also there were many cases of broken questions etc. which put me off attempting them as it didn't seem efficient and would lead to confusion”. In reality, the number of questions with problems was relatively small. However, the lessons from the feedback included more agility required for the academic to address notified problems, and reducing or chunking the number of questions presented to students.

Mechanical Engineering

The online question bank was implemented into 12 separate sets of practice questions (Table 3) to allow students to practice the questions as often as they wanted without any marks. The questions presented became available to students in parallel to the lecture topics. Each set contained ~6 practice questions on average and were directly relevant to the lecture topic of the week. The degree of difficulty of the questions was designed to be advanced. A discussion forum was also set up on Moodle, so that the students could post questions to seek clarification. The forum was administered by the academic and his demonstrators.

Table 3: Implementation and usage statistics for Mechanical Engineering

Implementation	Description	Usage Statistics
Practice Quiz 01	Introduction, physical properties of fluids, fluids in static equilibrium, pressure measurements, manometer	1799 by 361 users (100%)
Practice Quiz 02	Forces on submerged plane surfaces, buoyancy and stability of floating objects, pressures in accelerating fluid systems	1436 by 356 users (98.6%)
Practice Quiz 03	Lagrangian and Eulerian descriptions of fluid flow, continuity equation, flow visualisation, Euler's equation of motion, steady flow energy equation	1087 by 345 users (95.6%)
Practice Quiz 04	Bernoulli equation, hydraulic and energy grade line, energy transfer and general energy equation	1068 by 337 users (93.3%)
Practice Quiz 05	Mid-Session Test 1	764 by 316 users (87.5%)
Practice Quiz 06	Linear momentum equation, forces caused by deflection of jets, forces on nozzles, linear momentum+Bernoulli/Energy equations	1204 by 340 users (94.2%)
Practice Quiz 07	Dimensional analysis and similarity, introduction to laminar and turbulent flow in ducts, Reynolds number, entrance region	1084 by 333 users (92.2%)
Practice Quiz 08	Laminar and turbulent flow in pipes, analytical solutions, Moody chart and Darcy friction factor	1091 by 324 users (89.8%)
Practice Quiz 09	Mid session test 2 Review	513 by 264 users (73.1%)
Practice Quiz 10	External flow boundary layers, characteristics of laminar, transition and turbulent zones. Drag on immersed bodies, skin friction, form drag, variation of drag coefficient with Reynold's number	761 by 281 users (77.8%)
Practice Quiz 11	Compressor, pump and pipeline characteristics	627 by 273 users (75.6%)
Practice Quiz 12	Turbines, centrifugal and axial flow and velocity diagrams	572 by 271 users (75.1%)
Exam sample	Sample of 2015 exam	958 by 333 users (92.2%)
Exam sample	Sample of 2014 exam	769 by 318 users (88.1%)
Exam sample	Sample of 2013 exam	595 by 264 users (73.1%)

The first implementation of the question bank in 2016 had resulted in very positive responses from the students (end of semester satisfaction: 5.29 out of 6). In the second implementation of the question bank in 2017, face-to-face tutorials were replaced with the online question bank, coupled with feedback forums. This had the added benefit of greatly reducing the room and human resources required to run the course, from 7 tutorial rooms and 7 tutors in 2016 down to 0 tutorial rooms and 2 tutors in 2017). In 2017, the online assignment was also made compulsory and contributed 20% towards the final mark of the course.

A critical reflection on the process

As seen in the previous section, the shared question bank did not constrain the way in which learning design took shape in the different courses. In each course the quizzes were used differently, accommodating both formative and summative assessment as well as providing an effective approach to support assessment and feedback processes. Here is the reflection on the process and outcomes, hinting at future directions.

Chemical Engineering Academic

ML felt that the question bank provided more flexibility and was more customisable than a commercial off-the-shelf question bank package that was trialled co-currently. The academic felt their Moodle question bank prepared their students for the tutorials and enabled tutors to quickly proceed to and focus on more advanced concepts during their tutorials. The academic did however feel that the question bank did not help students with critical thinking and advanced learning; they felt that more scaffolding to support students was required, perhaps in either face-to-face teaching or face-to-face tutorials in order to achieve this. The academic also felt that a standard matrix or benchmark for evaluating outcomes of the project would be useful to quantify the efficiency and cost savings of developing learning resources this way. One question around the question bank relates to the long-term sustainability of these resources, and the need for a university or faculty strategy for when the academic/education developer or student as partner leave the project; that is, how to handle project handover and continued development of resources. The fear is that the resources may become 'orphaned' as the course moves on.

Civil Engineering Academic

SF saw only some of their project expectations being achieved. The student cohort was quite diverse and the question bank was only embraced by some of these students. Once the marked online quizzes were completed (Week 7 of the course), student participation in the practice (unmarked) quizzes dropped. For some students, the practice quizzes were still a great medium to study; however, most students appeared purely motivated by marks in quizzes and other coursework assessments. A key learning experience from the project was that not all students work the same way. For many students, it is all about the marks; however, the academic sees the efficacy in providing practice questions as a scaffold for students who are motivated to learn further. Future adjustments will make use of weekly marked quizzes with a small number of questions to encourage continuous learning.

Mechanical Engineering Academic

SC experienced high usage of his question banks. Mechanical engineering had replaced its fluids face-to-face tutorials with online tutorials for the semester, and the usage patterns indicate that resources such as this are relevant and helpful to students in this context. The flexibility of the question banks enabled students to personalize their learning experiences. Students who needed assistance could still seek help through an online forum, while more advanced students could work through the questions at their own pace.

Student As Partner

Based on the feedback from the academics, students appeared to get a great deal out of the question banks. The use of open-source STACK question type was ideal for a minimum viable product and can be easily integrated with our LMS (Moodle). Having a software developer that has experience in this area would enable the team to overcome some of the challenges with the STACK question type, mainly relating to it being developed for mathematical subjects. As such, there were some challenges in terms of capturing the correct answers with precision, and providing personalised feedback to students based on ranges of incorrect answers. There is scope to have more flexible questions that adapt to student needs and provide personalised feedback. In terms of the question quality, students rapidly commented on minor errors in some of the questions. Whilst the questions did have a review process and testing was undertaken with a small sample of students, an improvement for future projects may be to implement a formal quality management system to better automate tasks such as tracking changes, version control and question testing. This should have the effect of minimising student complaints from errors in questions and avoid students choosing not to attempt the questions due to concerns over receiving incorrect feedback.

Educational Developer

The project was successful in several ways. Firstly, the team achieved their objective of designing, developing and implementing the question bank databases into their courses. The project was a collective response to the academics' instructional awareness, that is, their understanding of their teaching pedagogy and practice and how this could potentially be improved to benefit their students (Fang, 2011). The team did quickly realise that the success of the project hinged on the importance of creating a minimum viable product that met a common need for all team members. This highlighted an area for potential improvement in Moodle, which is currently being explored at the university, where the ability to share and continuously sync question bank categories across multiple courses could be of benefit to future similar teams. Early agreement on the project need, clearly defining the project and agreeing on deliverables meant that the team started developing resources early and kept this momentum up throughout the project. The student partner was a welcome addition to the team and his contribution to the project was invaluable in designing questions, building these into the course and running focus groups for feedback. Overall, the team dynamics were quite unique in that the developer noticed that the team are still collaborating months after completing the project. Examples of this include the team applying for grants together, and recognizing other opportunities to collaborate, for example on a project involving sharing lab resources. The developer attributed this to the key factor of the team having the right mix of personalities, and the same individual inherent motivation to improve their students' learning. It was inspirational for the developer to see the team members, all with distinct personalities and competing interests, come together as colleagues to work on one project, and form a community of practice where they continue to add value to each other's practice.

Conclusion and future direction

As evident from the various team members' reflections, the student feedback in end of semester evaluation, and overall student performance, the main takeaway message is that the integration and collaboration presented to produce a single, shared, portable resource to support student assessment of their knowledge of fluid mechanics was a success. By exposing the reflections on the process, this paper follows the lines of McKenna et al. (2004), making explicit the process for others to observe and learn from. The variety of skills available in the team provides a template to support further integration at faculty level and demonstrates the usefulness of peer support, students' engagement and efficient development. The success of the inter-school collaboration in this project also presents a potential future opportunity for cross-university collaboration in the development of shared resources. Of course, there are several technical improvements that can be made to support further development and sustainability of the resource deployment. Further, more fine-grained research is also underway to explore in more detail student learning and their acquisition of key concepts.

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