The TEAM Project: Insights from Developing a National Project Focused on Enhancing Assessment in Science and Health Practical Sessions with Digital Technologies.

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Abstract.

In Higher Education, science and health degree programmes involve significant practical elements. In many cases, students spend as much time in practical or clinical skill sessions each week as they do in classroom based lectures. These hands-on sessions engage students, develop both soft and technical skills, while allowing theory to be put into practice. However, in many cases, the design, assessment and feedback aspects of practical sessions has not received the attention warranted, with traditional approaches often persisting. This paper discusses a nationally funded, multi-institution enhancement project focused on implementing and evaluating digital technologies to enhance assessment in science and health practical sessions. Via an initial baseline analysis, four thematic areas were identified for pilot development: [1] Pre-practical videos combined with online/app quizzes, [2] Electronic lab notebooks, [3] Digital Feedback and [4] Rubrics. In collaboration with student partner groups, employers and academic staff, the TEAM (Technology Enhanced Assessment Methods) project designed and implemented 42 pilots in practical sessions across the four partner colleges, engaging almost 1,600 students. In this paper, the key lessons identified during the baseline analysis which informed the project, as well as those from the subsequent survey and focus group evaluation of participants' pilot experiences, will be presented. Overall, the implementation of TEAM has represented a major success across the partner colleges, providing a strong foundation for continuous, iterative improvements in this field.

Keywords: Assessment, Digital, Employability skills, Feedback, Practical, TEAM, Technology.

1. Introduction.

Educators are currently navigating the era of assessment. In recent years, there has been a significant focus on the implementation of formative (for learning) assessment. However, while these initial advances have transformed elements of education in the classroom, other learning spaces can sometimes remain untouched. For example, the practical environment is often not awarded the attention it deserves.

During science and health degree programmes, students spend significant time in a practical environment, be it in a respective laboratory or clinical skills session. For many, the practical environment represents an opportunity to develop hands-on, technical or clinical skills. While this does occur, there are numerous other levels of learning that can take place during these sessions – but only if the associated design and assessment strategies are considered in advance. Elen and colleagues (2007, p.115) outline how in a 'powerful learning environment', students "*assume full responsibility for the construction of their knowledge…..in a comfortable context that offers targeted support from teachers to render their activities as effective as possible*". In the practical environment, students put theory covered in lectures in to practice; gain hands-on experience of equipment/patients/animals; develop technical, academic writing, group-, peer- and self-assessment and data analysis competencies/skills (Boud & Falchikov, 2006; Bree et al. 2014; Hofstein & Lunetta, 1982, 2004; Pickford & Brown, 2006; Prades & Espinar, 2010). Hence, the potential of these 'powerful learning environments' is vast, whereby students can gain significant employability and soft-skills, but also, given appropriate assessment processes, develop self-regulation.

1.1 Design and format of practical sessions.

In order for a practical session to begin reaching its learning potential, its design is vital. Domin (1999) outlined the impact of the various instructional styles; namely expository, inquiry, discovery and problem-based. Traditionally, practical sessions in science disciplines have employed an expository approach – whereby students worked towards a pre-determined outcome, using a pre-determined procedure. While there is a need for this system to develop protocol adherence skills in our students, its dominance can lead to students becoming solely focused on achieving the required results and completing the session, whilst not considering practical design approaches, problem solving or troubleshooting in addition to metacognitive skill development (Caspers & Roberts-Kirchhoff 2003, Roberts 2001). Combining the expository with more active aspects/roles and student-led styles and activities such as problem-, or inquiry-based learning have been reported to be highly effective (Mc Donnell et al. 2007, Hart et al. 2000, Hofstein & Lunetta 2004, Domin 1999, Garcia 2004, Weaver et al. 2008, Saribas & Bayram 2009, Branan & Morgan 2010, Donaldson & Odom 2001, Sato 2013, Henkel et al. 2015). Weaver et al., (2008, p.577) outline how inquiry based approaches focus on "*engaging students in the discovery process at some level*" and, without forgetting benefits of the expository style, marrying this engagement with an active and participant role can only benefit the learning process and the students, further.

1.2 The essential nature of assessment & feedback.

With practical sessions central to the student experience and skill development, it is vital that suitable and effective assessment and feedback approaches are used. As educators, we are aware from both literature and personal reflections of the importance of assessment – an element "*at the heart of the learning experience*" (Black & Wiliam, 1998; Brown & Knight, 1994 p.12; Brown, 2004; Miller et al. 1998; Prades & Espinar, 2010). In the assessment era, the introduction of formative approaches and activities can have a positive impact on the students' approach to learning (McDowell et al. 2011). Hence, when we consider the prevalence of traditional approaches to practical assessment methods, namely laboratory reports in science sessions (Aurora 2010; Bree et al. 2014; Hughes 2004; Hunt et al. 2012; Mc Donnell et al. 2007; Pickford & Brown, 2006; Whitworth & Wright 2015; Timmerman et al. 2011), or the Objective Structured Clinical Examination (OSCE) in clinical skills sessions (Linn et al. 1991; Newble 2004; Rushforth 2007; Brosnan et al. 2006; Oranye et al. 2012; Davis et al. 2006), there remains scope for complementary, and potentially digital, elements to be introduced to improve the learning experience.

Living 'hand-in-hand' with assessment is feedback – described as "*the oil that lubricates the cogs of understanding*" by Brown (2007, p.1) and the "*single most powerful moderator to enhance student activity*" (Hattie, 2003, p.8). Boud and Molloy (2013) recommended feedback be positioned as a fundamental element in curriculum design, one that translates to day-to-day practices and is targeted at developing student self-regulation. The past twenty or so years have seen increasing recognition of the potential of feedback to promote learning (Carless et al. 2011, Kulhavy et al. 1985, Price et al. 2010, Winstone et al. 2017, Winstone & Nash 2016). Carless (2015) states that "*information only becomes feedback when it used productively*" in addition to subsequently presenting the model of a "*feedback spiral*" to represent longer term, and iterative, learning processes (Carless 2019). In recent times, it is becoming more commonplace for learners to access their feedback via technology enabled approaches, for example via their Institute's virtual learning environment (VLE).

1.3 Technology in higher education.

On a daily basis we are experiencing the presence of, and engagement with, technology. In the Higher Education arena, there have been numerous recommendations regarding the implementation of technology for student learning (European Commission 2011, National Forum for the Enhancement of Teaching and Learning in Higher Education 2015, Redecker 2017). Many Higher Education Institutes use VLEs and employ eLearning co-ordinators and learning technologists to lead and develop approaches to support staff and students. Indeed, the (Irish) National Forum for the Enhancement of Teaching and Learning in Higher Education considers teaching and learning in a digital world as one of its key strategic priorities. At a European level, a published framework for digital competence of educators provides a platform positioning pedagogy first, while presenting six distinguishing areas comprising 22 competencies (see Redecker, 2017). This framework provides a reference for various courses and training initiatives to be guided by, which can assist reaching its potential to increase the engagement and implementation of digital competencies.

In general, many educators are engaged in technology-enhanced learning, however, given the importance of the practical learning environment, it is important the digital transformation occurs there also.

1.3.1 The TEAM project – revising assessment in practical sessions with technology.

The Technology Enhanced Assessment Methods (TEAM) project represented a 2-year, multi-institutional approach that aimed to incorporate digital technologies to enhance the manner in which assessment takes place in science and health practical settings. The project was funded by the National Forum for the Enhancement of Teaching and Learning in Higher Education. Dundalk Institute of Technology (DkIT) led the project in collaboration with partners Athlone Institute of Technology (AIT), Institute of Technology Carlow (IT Carlow) and Institute of

Technology Sligo (IT Sligo). The project centred on implementing technology-based assessment and feedback approaches in practical settings to enhance learning. This article focuses on the evaluation of the project and the objectives for this were:

1. To gather baseline data on students' perspectives and experiences of practical assessment in Science and Health.
2. To gather data on lecturers' experiences of technology-enhanced assessment approaches.
3. To evaluate specific implementations of technology-enhanced assessment approaches in practical sessions.
4. To draw broader conclusions about the potential of digital technologies to enhance the student experience of practical sessions and to inform the development of these approaches.

In this paper, we detail how the project was designed, governed, and implemented. In addition, we present the key findings that emerged from the general evaluation.

2. Methodology.

This section details approaches to three aspects of the TEAM project; (i) its governance and phased structure, (ii) the methodologies associated with the baseline analysis that informed project design and (iii) the methodologies associated with the pilot implementation and mixed-method evaluation.

2.1 Project governance & phase structure.

A steering committee across the four partner institutes engaged and collaborated with multiple stakeholder groups to inform, design, promote, roll out and evaluate the TEAM project (for example, student partner/advisory groups, regional employers, library and IT teams). We also engaged with an external project advisor[1]. The project was structured across three phases (see Figure 1).

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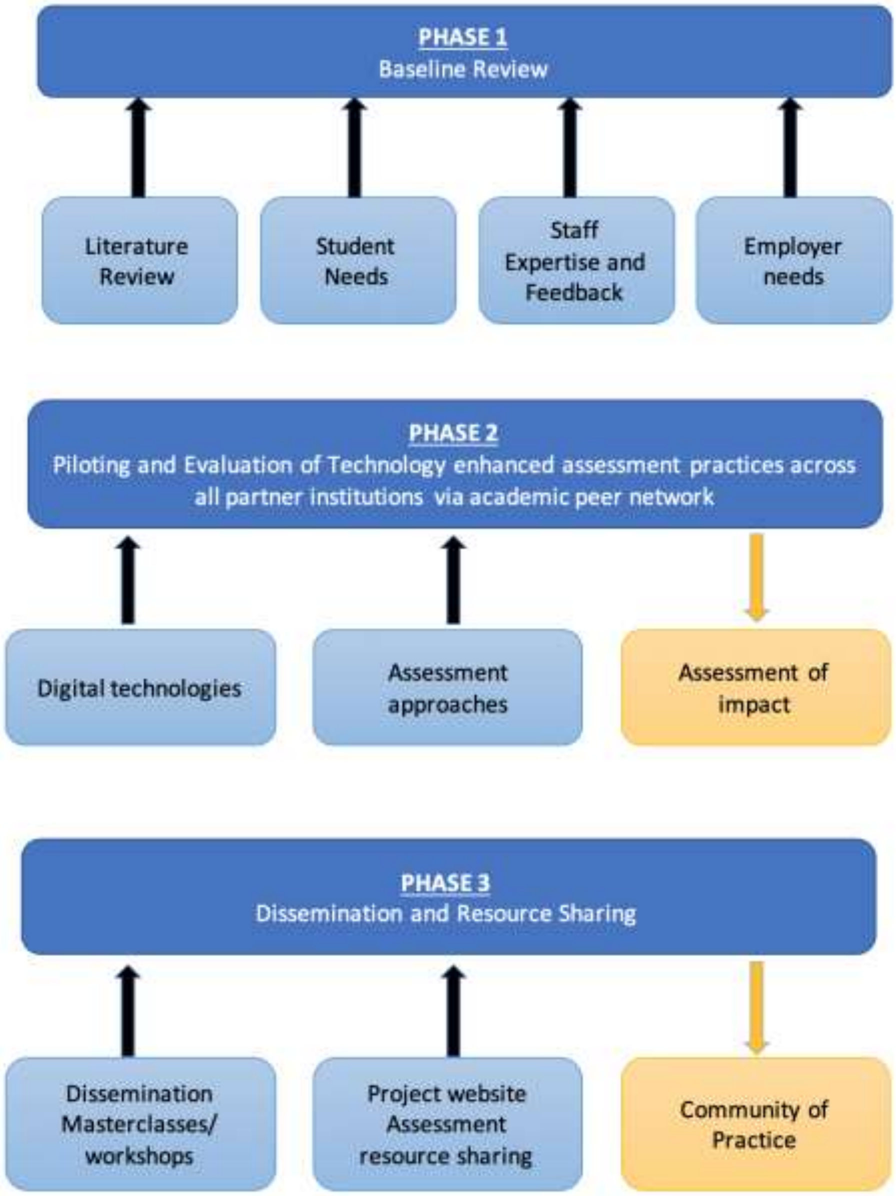
Figure 1: An overview of the project phases with inputs and outputs indicated.



2.2 Determining a baseline to build from.

Once the stakeholder teams were established, a baseline analysis was performed. Its purpose was to engage with the literature and various stakeholders to determine the level of baseline technology use in practical assessment and to inform the project (See Figure 1; phase 1 and

Figure 2).

- Initially, a student-staff workshop facilitated collaborative discussions and helped determine opportunities for development.
- At career/industry events, in addition to reaching out to relevant industry contacts, semi-structured discussions took place around the project's brief and aspirations as well as the skills needs of each of our regional graduate employers.
- A key aim of the baseline analysis was to determine the view of our learners at that time; to gain a snapshot on how practical aspects of their courses were being assessed, and if technologies could be introduced to assist this. An ethically approved anonymous survey was circulated to students in hard copy (as recommended by our student advisory group). There were 688 responses. IBM SPSS Version 17 was used to analyse the data (see appendix 1 for baseline survey questions).

Insights from the baseline survey, in combination with the project's literature review (Bree, 2018) and interactions with student advisory groups, industry stakeholders, and workshop feedback were reviewed to identify technology themes future pilots should centre on. These were digital feedback, rubrics, pre-practical preparation and electronic lab notebooks.

2.3 Pilot implementation and mixed-method evaluation.

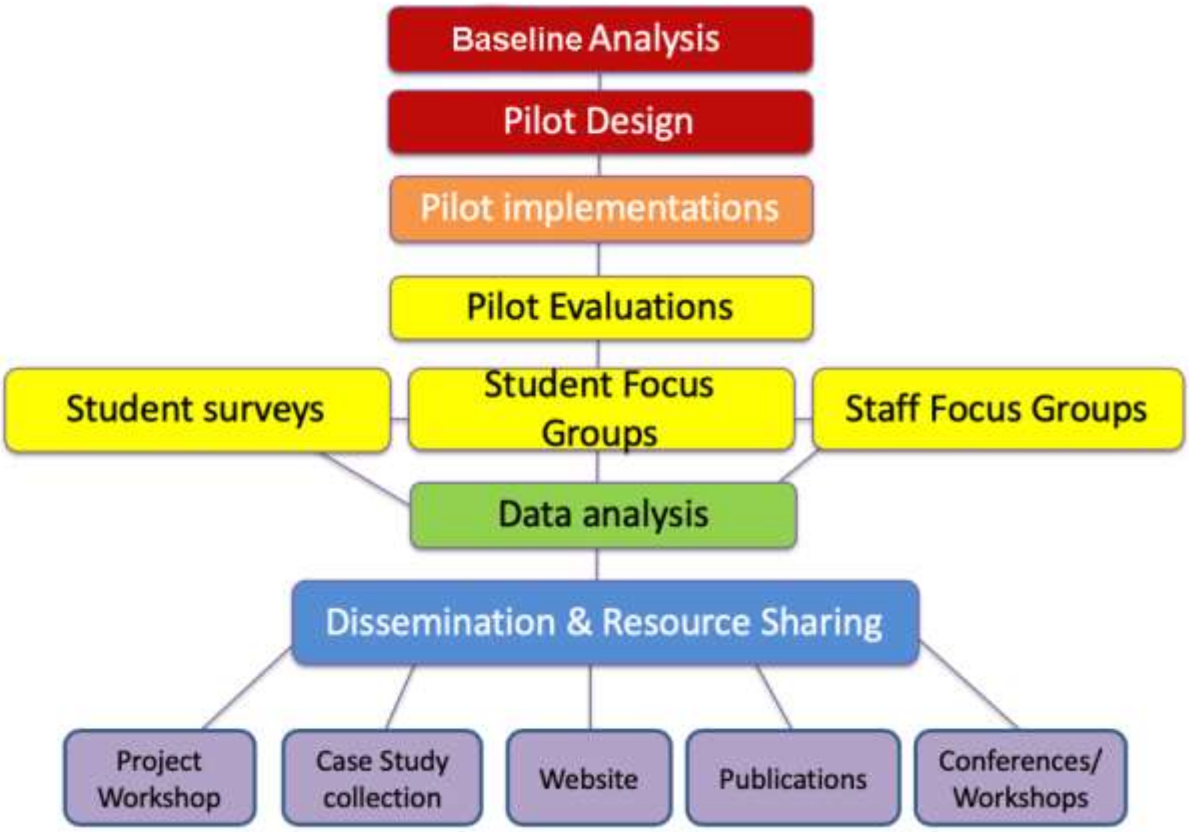
To support the implementation of the technologies across the partners, a pilot-based approach was designed and established (See Figure 2). In total, 42 pilots were carried out; 3 focusing on digital feedback, 6 on rubrics, 16 on pre-practical videos/quizzes and 17 involving electronic lab notebooks (ELNs).

These were evaluated using a mixed-methods approach and this was ethically approved in each participating institute. No questions were mandatory and all participants were aware their voluntary participation/non-participation would have no influence on grades. To allow a cross-project analysis to take place, questions 1-5 of each survey were identical, while the remainder were selected from a master bank of approved questions by the relevant academic staff member to ensure evaluation of their own specific pilot. A total of 1,591 students across the partner colleges who experienced a pilot were invited to voluntarily complete their pilot's ethically approved, anonymous online evaluation survey that contained 10-15 questions. The student survey response rate was 31.4%.

The evaluation also included 12 semi-structured, audio-recorded, one-hour long focus groups (See Figure 2). Here, a volunteer convenience sample was recruited from participating, and therefore eligible, students and staff. Those interested in participating responded directly to the project administrator, who co-ordinated the arrangements for each focus group. Teaching staff were not made aware of who had participated/not participated, nor were they involved in their moderation. Specifically, the focus groups were conducted with volunteering students, staff and TEAM project academic leads, with each designed around and following Krueger's (2002) recommendations. Six focus groups engaged with staff (n = 27) while six engaged with students (n = 24). In each case, ethical approval was obtained in advance. The focus groups were organised around a group of predetermined open-ended, guiding questions (see Appendix 2). Audio recordings were transcribed professionally, with all names or identifying features redacted.

From the pilot survey evaluations, the data analysis phase generated pilot-specific reports of the evaluations. This assisted academic staff in obtaining key insights in to their pilot, while providing them with data for conference presentations or publications and ultimately to inform their teaching practice. All data, from both the focus groups and open-ended survey questions, was thematically analysed and triangulated, using Braun and Clarke's phased approach (2006) and Bree & Gallagher's analysis method (2016). The process was reviewed independently by other members of the project team in order to increase the validity and reliability of findings (Cohen et al. 2007). A key focus was then to promote various dissemination of the lessons identified (see Figure 2).

Figure 2: Flowchart overview of the project methodology.



3. Results & Discussion.

The TEAM project aimed to introduce new assessment formats to practical sessions using digital technologies. Initially, the baseline analysis informed the project regarding its design, chosen technology and assessment tools. It also helped determine the interest of various stakeholders in the project concept. In this section, results from this baseline analysis (section 3.1), followed by findings coming from the evaluation of the subsequent pilots performed (section 3.2), will be outlined.

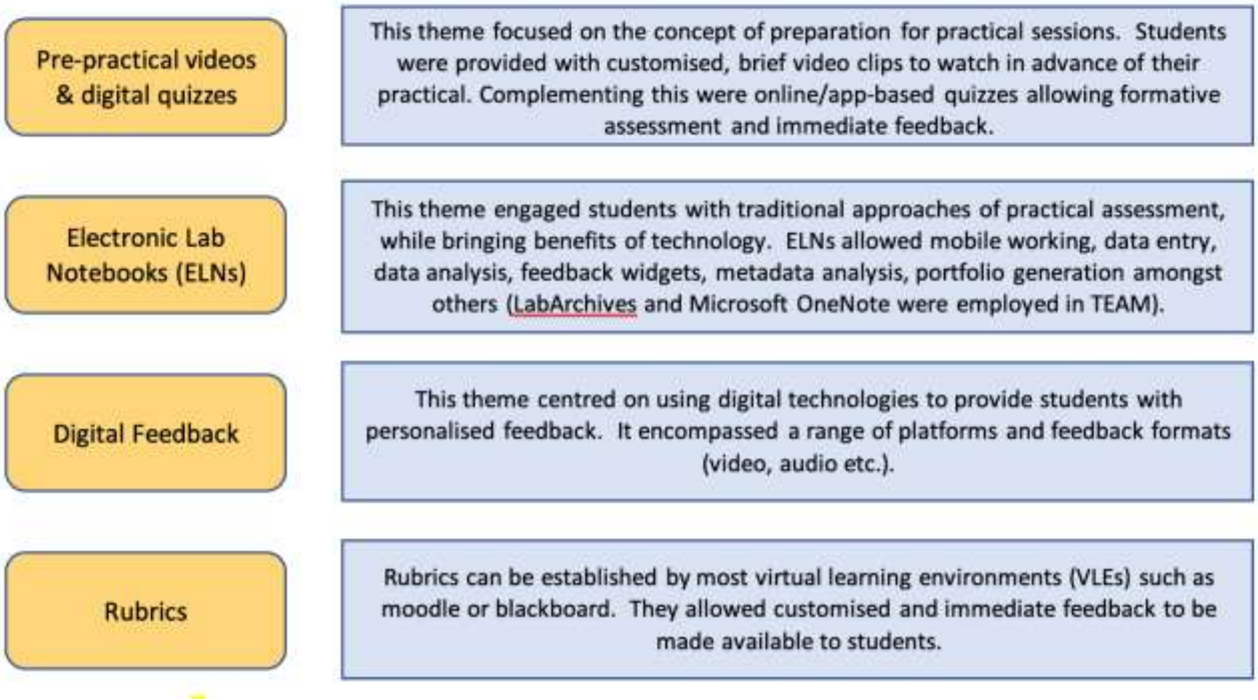
3.1 Insights from the baseline analysis: determining interest levels and approaches to re-align practical assessment with digital technologies.

The baseline analysis identified elements of both assessment and technology that could offer solutions to improve the student learning experience, informing the TEAM project's design. The analysis showed students valued their practical sessions and in general, were positive about assessment. They had little direct experience of using digital technologies in their practicals but showed an enthusiastic attitude towards implementing them, particularly post first-year (73% indicated they would like to see more technologies implemented). For specific technologies (Socrative, Online tests, Online quizzes, Audio feedback, Virtual labs, eLab notebooks, Pre-practical videos, Video/screencast lab report, Online fora, Apps), the number who would like to see each used exceeded the number that would not (except in the case of video/screencast laboratory reports). A general summary of the quantitative survey results were presented at various conferences and associated proceedings (Bree et al., 2017a; Bree et al., 2017b; Kavanagh et al., 2018).

Interestingly, feedback from employers highlighted their own moves to software-based approaches for some of their analyses and reporting which will reduce paperwork and increase productivity overall. They reported external auditors are also being trained on software packages so they can ensure while auditing that nothing is hidden or changed in electronic systems. Generally, conversations around the concept of electronic lab reporting/notebooks received positive backing. Support for new ways around using technology to deliver feedback to learners and promoting self-reflection on one’s work were equally recommended.

Ultimately, the baseline analysis determined an interest in the re-alignment of practical sessions to enhance skills and identified four main technology themes that pilots would centre on - [1] pre-practical videos combined with online/app-based quizzes; [2] electronic laboratory notebooks, [3] digital feedback and [4] rubrics (see Figure 3 for a detailed description of each technology theme). Implementing these themed pilots modified the standard format of practical sessions across the four partner institutes - reaching 45 programmes. These pilots introduced new assessment approaches to practical sessions, each focused on enhancing learning and skill set development.

Figure 3: An overview of the four technology themes identified during the baseline analysis for pilot evaluation.



3.2 TEAM pilots; the results.

In this section, findings from the pilot evaluations are presented (see Figure 4). Positive aspects, challenges encountered and areas for improvement will also be discussed to create an understanding of the student and lecturer experiences from engaging with the project.

Figure 4: An overview of the key elements being evaluated

3.2.1 Student survey insights: gauging the general experience of TEAM technologies to promote assessment and learning.

As part of the pilot evaluation survey circulated to students, the first five questions were common across all 42 pilot evaluation surveys. Reviewing responses to these questions, students reacted positively after engaging with new assessment technologies during practical sessions with 84.7% reporting they would like similar technologies to be established across other modules (see Table 1).

Table 1: An overview of responses to the common questions in the pilot evaluation surveys.

1	Do you feel more confident in using digital technologies to enhance learning and understanding as a result of your engagement with method used as an Assessment method?	**Very Much**: **45% (176 responders)** Somewhat: 16.9% (66 responders) A little: 32% (125 responders) Unsure: 0.3% (1 responder) Not at all: 5.9% (23 responders) 391 responders
2	Compared to other interactions with technology in college that you have experienced, how would you rate/comment the approach used in this module/initiative?	**Excellent**: **25.1% (89 responders)** **Good**: **54.6% (213 responders)** Average: 14.6% (57 responders) Fair: 5.9% (23 responders) Poor: 2.1% (8 responders) 390 responders
3	Would you like this approach to be established in other modules?	**Yes**: **84.7% (326 responders)** No: 15.3% (59 responders) 385 responders
4	Did you experience any particular difficulties with the method used as Assessment approach implemented in this project? (open ended question)	Yes: 43.4% (158 responders) **No**: **56.6% (206 responders)** 206 responders
5	What did you like most about using the technique as Assessment in this way? (open	➢ *time saving* ➢ *accessibility*

	ended question)	➢ *collaborative space* ➢ *improved learning/ building confidence* ➢ *fun* *(indicated comments explained below)*

Interestingly, 56.6% stated no particular difficulty was experienced with their pilot's technology, expressing a strong user-friendliness and ease of use; it helped them to learn and was easy to follow. However, 43.4% reported encountering difficulties when engaging with a new technology-based assessment method. Those students explained it was sometimes time-consuming, and accompanied with hard-to-follow instructions, mainly associated with challenges around set up and accessibility.

When students were asked to comment in the survey on the element they enjoyed most during the pilots, they regularly mentioned that their technology was easily accessible, time saving, while helping them to build confidence and be more prepared prior to practical classes. Hence, the choice of technology, and specifically its accessibility, can influence the learners' experience. In relation to the ELN based pilots, students enjoyed the collaborative nature of the technology as they could share their knowledge, skills and experience with peers and lecturers through the collaborative spaces available in the software programmes. One of the students commented in relation to accessibility:

''I liked the way I could work on my project anywhere I was in my spare time, on my phone".

Students regularly reported they felt more confident prior to their lab session after watching pre-practical videos. They felt more prepared and knowledgeable before going to the session:

''I liked the pre-practical video because I felt more confident in the lab as I knew what was going on and could learn it at my own pace".

Students reported enjoying an element of "*fun*" while engaging with technologies. They felt the teaching method was different compared to their typical class structure which made it more exciting and interesting to be involved in the process:

''It was different, it was fun and I find I learn more from practical (work) rather than theory (classes)".

3.2.2 Focus Group insights from a student and staff perspective: general benefits of digital technologies in the practical environment.

Echoing the survey, the positive aspects were highlighted by students included easy access to the material, user-friendly technologies, time saving, collaborative spaces and a '*fun*' aspect. One student, in relation to accessibility to the material when using ELNs, highlighted a paper laboratory report can easily be misplaced compared to an electronic report that is always available with their notes and feedback, that can be reviewed at any time.

''… sometimes you're doing lab reports and one of the results, or a copy or just notes for yourself, go missing so you can't, you don't have them anymore, and some of the lab reports you don't get them back……but they're online, they'll always be there, you can always refer back to them whenever you want as well."

In fact, the user-controlled templates, searchability, back-up of data, remote access and 'ease of use' aspects are just some of the many reasons as to why industry and academia are considering adopting a shift to electronic reporting (Kihlén 2005, Nussbeck et al. 2014, Johnston et al. 2014, Kihlén & Waligorski 2003, Hall & Vardar-Ulu 2014, Machina & Wild 2013).

A common aspect evident in the data evaluations was that students realised engaging with technologies gave them confidence and in the case of pre-practical videos, significantly assisted preparation going into the sessions. Students enjoyed the fact they could share ideas, or difficulties, with their lecturers and classmates in the online "*collaborative space*". One student demonstrated the positive aspect of collaboration when using the ELN software:

'' I think the main strength has been the collaborative space. Like I think really a lot of students don't tend to understand their data, they tend to just put it down on paper and think 'That's fine, we'll go with that.' The collaborative space actually enabled us to think and understand

what we were actually putting down."

With regard to the concept of feedback provision, numerous student responses commented on the benefits of using digital technologies. They enjoyed the accessibility of the feedback as in many cases, they could pause, rewind and replay as many times as required – a helpful aspect for international students. One student specifically highlighted the accessibility and replay function of digital feedback:

"I listened to it a few times and picked up a few different things each time and then like that, you can pause it, you can write something down, you can, it's just nice to actually hear the feedback"

Overall it was clear from focus group responses that students felt the technologies helped them to manage their learning process by saving time, having their material all in one place (ELN's), being able to access the material at any time and replay feedback (digital feedback), feel more confident and prepared prior to their class/exam (pre-practical videos) and quickly assess their results (rubrics). In addition, it helped them prepare for future exams and/or assignments and to identify areas for improvement. Furthermore, lecturers and students continued to mention in many of their responses that technologies were improving employability and job-related skills. One of the students stated:

''…and it was great and you learned how to do group work, you learned how to use the computers, technology, the whiteboards, you got to learn how to like not ask the lecturer for absolutely everything, to do it yourself, there was so many advantages to it and I think that was the start of us really going on to learn different technology stuff like the screencast and the Socrative and that like it was, it was brilliant. I think it's good, it was my favourite way of being taught."

Many lecturers shared their opinions in relation to the impact of the technologies on students' future careers:

''…it does provide them with very good training particularly in science and going in to industry where they are going to be using a lot of online systems,

getting them used to that kind of format, it's definitely very good" (ELN's)

Interestingly, all four technology themes incorporated elements of feedback, which is required to ensure students know how to improve and develop their learning (McLoone 2009). Rubrics provided clarity around feedback, were easily accessible and allowed students to visually identify their strengths, and areas for improvement. ELN platforms incorporated both a collaborative space, where group discussions/general feedback was possible for student groups, and a private space where they could receive individual feedback. Pre-practical videos combined with app-based quizzes allowed students to self-assess by completing a quiz after watching a video. Digital feedback was providing students with an opportunity to improve their understanding, performance and skills going forward:

"…we got feedback with the rubric filled out how we got on. So, it was good in that aspect where the lecturers structured what's getting marks and what detail was required in those sections to get top marks. So, it helps you to see where I can improve and what needs to be done and other aspects to get a higher grade."

3.2.3 Focus group insights: implementation approaches & challenges encountered.

Students highlighted the way a new technology was implemented by a lecturer had an impact on the effectiveness of the tool. Students felt they were more engaged with the process when the lecturer was confident and had relevant skills to deliver the new technology. Students who felt their lecturers were less familiar with the technology did not engage well with the process and found it challenging to learn in this way. Needless to say, the training and preparation is, and will be, a vital element for a successful, engaging class in which the students learn and enjoy the process. There were reports of accessibility issues amongst both groups, with certain students highlighting they were unable to access the software from home, however it was not clear whether this was associated with the software platform or due to other issues such as a possible lack of high-speed broadband access.

During the staff focus groups, when lecturers were asked to reflect on their experience of engaging with new assessment technologies, many described challenges. They referred to the time required to learn and set up new and unfamiliar technology platforms, explaining the importance of developing skills to improve their knowledge and confidence when delivering a new technology to students.

> *''So, for me there was a time commitment in setting it up and really figuring out what I was doing, but that is going to be with anything you try.''*

> *''…Like, the tools are there, it is down to your competency ……. there is great scope there for flexibility within it. I think it is just my competency needs to, maybe can be, improved a little bit.''*

Lecturers highlighted that support and training was essential from more experienced professionals to assist them in developing the necessary skills but felt that with time, it became easier to use and implement the new technological tools and overcome challenges they had at the beginning.

> *''…I suppose you spend all this time developing a new strand of your teaching practice and you know sometimes you wonder why you're doing this and you put so much time into it but actually that when you do it's that first run out that takes the time and then you can reap the benefits really and not to be afraid to take on new technology because there are benefits to it but there has to be a benefit to you as the lecturer but also to the students.''*

> *''….I do think the first term that you roll these new things out is always going to take more time and you'll only reap the benefit of that the next time out and that's when you see the time savings, really you don't see the time savings in the first roll out of it because it takes you so much time to get it off the ground.''*

In essence, and ultimately, the challenges were transformed into enablers; improving skills, knowledge, efficiency and confidence; but this process can be enhanced and expedited if further supports are in place, in particular at the onset of the process. Moreover, lecturers with prior experience of certain technology areas, shared their experience with other academics which in turn improved knowledge and skills for less experienced staff.

> *"….I think just with the project, it kind of gave a chance to maybe share some of my*

> *experience, some of my expertise of this specific technology, maybe teaching approach, and that's probably the reason why I would have got involved in that."*

While for many academics who engaged with the TEAM project, it represented the first time they utilised certain technologies or approaches, for others it provided an opportunity to re-engage with technology-based assessments:

> *"…when I took that module* (Technology enhanced learning) *on at the beginning I would actually be somebody who was like I don't want to know about technology. I'm not very technical savvy at all. But that module was great, I totally got involved in it but I found since then I've kind of, work gets so busy, you kind of put it to one side again and you kind of forget about it to some extent. So what this has done for me is kind of re-engaged me with the technology again which for me is a positive because I'm kind of going okay I've tried this* (technology) *out* (before) *and I want to try something else.''*

As part of TEAM, certain pilots were implemented whereby science students generated and submitted their laboratory reports using an ELN platform. The engagement with ELNs involved digital technologies that differed from other digital tools piloted in the study by their structure, software and complexity. From evaluating the ELN experience, students and staff expressed their opinions from using various software programs adopted.

> *"What I saw of the engagement of the students, they engaged way better than any time I've ever gotten them to write anything"*

Both groups reported it was important to find the most appropriate software platform in terms of importing data, graphs, locating reports, editing, sharing information and receiving feedback. As referred to in Figure 3, two ELN software packages were utilised in this aspect of the TEAM initiative (LabArchives and Microsoft OneNote). For many, this was a new experience and therefore lecturers and students faced some difficulties particularly at the beginning when inputting data and editing. Some students and lecturers reported accessibility issues, and certain students highlighted they were unable to access the software from home (*possibly due to the lack of high-speed broadband access, but this was not specified in their responses*). This certainly demonstrated the significance of using an accessible and suitable platform in order to ensure the effectiveness of the tool.

> *"I can see the value of it* (ELN)*, I can see the students are more willing to engage with this and I think if we could find the right one that works well for them and for me, I think it would significantly improve this whole aspect of practical assessment."*

Across the staff responses, it was clear lecturers expressed their willingness to utilise technologies going forward. They commented on the new interests and skills acquired, and felt they were in a better position to collaborate on projects with other staff and between different department members. If difficulties arose, they were glad to know that they were not alone in trying to find a solution. They enjoyed the fact other lecturers were sharing their experiences and were able to learn from each other – even across partner institutions.

> *"The collaborative aspect of this as well, the fact that you know it's not just you alone trying out a piece of software to see if it will do what you want it to do, you had other people also trying it out and then you have someone to discuss it with, what you were finding difficult, what you found good."*

> *"I quite liked that collaborative nature of these types of projects. I have always felt that I can learn far more from my colleagues and what's going on even here in [institute] and even outside of [institute] because this is a project that includes several other institutes as well. So there is a huge amount to be learned out there from one another. And it's very, because when I had that question about feedback, I had somebody external here to [institute] to actually go and ask the question to - rather than me sitting there trying to figure out is there something here that I should know what to do….and I can't figure it out".*

In fact, a key finding from staff feedback was the importance of the support system. This sharing of experiences with colleagues was a welcome add-on to being involved in the TEAM project. It will be important to prioritise maintaining current contacts and discussing/sharing best practice with current (and newly recruited) colleagues. Becoming involved in various teaching and learning focused projects can be a motivating experience for all involved:

"….and I was very motivated by the students' enthusiasm, so when they were enthusiastic about it, it actually made me more enthusiastic about it".

Furthermore, lecturers explained it was important to embed new ways of learning not only into a relevant module, but across programmes. Lecturers highlighted the significance of funding, support and appropriate inter- and intra-institutional structures to ensure the effectiveness of employing new technologies for teaching practices.

3.2.4 Students and staff identify a common goal

Overall, the majority of both student and lecturers involved in the pilots enjoyed engaging with, and implementing, new technologies. Interestingly, both groups indicated an eagerness and willingness to use technologies more going forward. Thus, by having a common goal, together lecturers and students can collaborate to maintain the implementation of new technologies.

It was evident both groups had identified the same goal as the TEAM project itself - implement digital technologies to improve the learning experience for students and to prepare them for their future careers. From responses gathered, it was clear the technologies helped some students to develop confidence, knowledge and to improve their employability skills. According to the evaluation survey, 45% of student responses stated "very much" when describing their level of agreement around feeling more confident when using digital technologies to enhance learning and understanding (as a result of taking part in a TEAM pilot).

Students did express their feelings towards the impact of the technology on their future careers:

''I think it's brilliant and I think it's a well worth time thing to be looking into because like I said, it's going to be the future no matter what anybody says, technology is just taking over everything and it's nice to be included in that instead of trying to fight it."

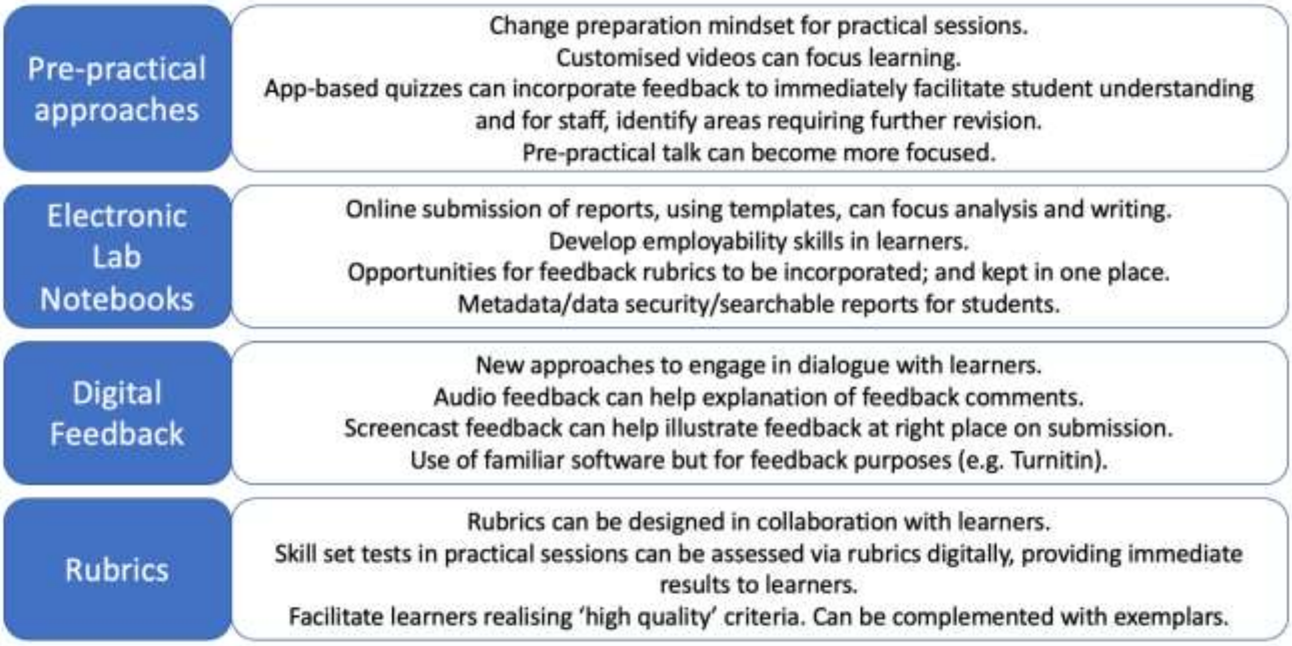
4. Conclusion & Considerations.

Across the partner colleges, TEAM has led a transformation of the practical assessment experience primarily for learners, but also for many academic staff. Technology is now an ever-present tool and with support, structure and training has the potential to significantly benefit students in their future careers. Collaboration, teamwork, improved engagement and learning as well as employability skill development represent just some of the benefits highlighted by students and staff in this study after engaging with new technologies. Their voices place a substantial emphasis on the importance of embracing new technologies and to adjust teaching practices accordingly to improve the learning and teaching experience. A strong example of adjusting practice in the sciences was the engagement with electronic reporting, as it mirrors new industry standards. The implementation of pre-practical videos and quizzes empowers learners to take ownership of their preparations for practicals and invites them to engage with immediate app-based feedback to begin the development of self-reflection. VLE incorporated rubrics and other modes of digital feedback complement this self-regulation throughout assessments. Overall, in these pilots, technology was seen to be able to connect, engage and motivate both students and academic staff.

In general, the technologies implemented across the TEAM project can be used to promote assessment and learning in practicals, each in different ways (See Figure 5).

As identified in the section 3.2.3, when considering the introduction of a new technology, the initial implementation approach is a vital component in engaging students and ensuring the effectiveness of the tool being implemented. It is important to prepare and specifically pilot any new technology prior to being rolled out formally to class groups. Structure, time, support and appropriate training for lecturers will allow the provision of essential preparation insights and knowledge sharing when delivering a new technology method to students. Technology practices must be embedded based on pedagogical principles, rolled out at an appropriate time and introduced at a suitable pace to ensure achieving the intended, and required, benefits.

Figure 5: An overview of how the digital technologies implemented during TEAM can be considered to promote assessment, learning and skill development.

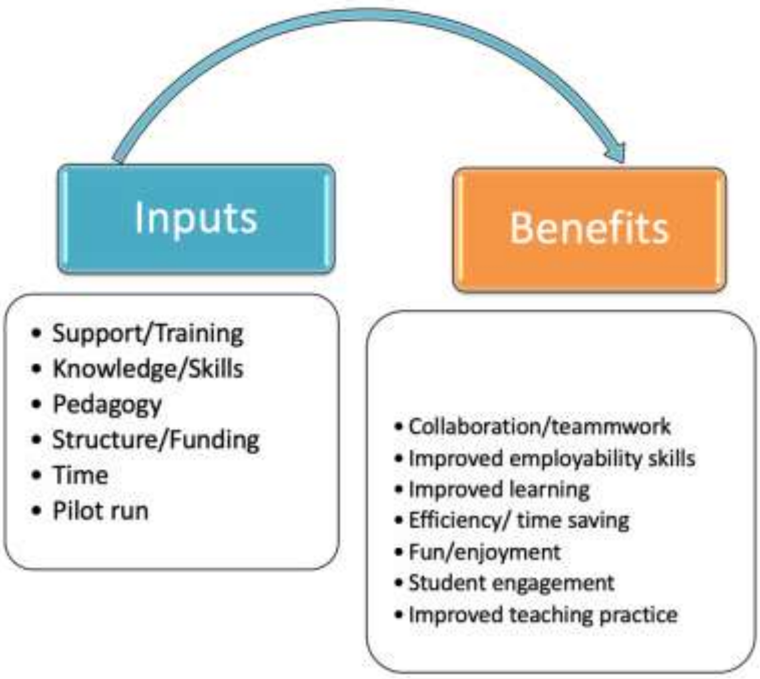


Reflecting on the TEAM experience and for those weighing up the implementation of digital technologies for assessment in practicals, and beyond, the authors recommend:

1. the technology selected must be appropriate for the module and/or programme
2. a structure is in place across modules and programmes
3. resources and funding are available for equipment and lecturer buy-out
4. training and ongoing support available for lecturers and students
5. lecturers become open to embracing and piloting new technologies; promoting a '*give it a try*' mentality
6. establishment of a peer support network to maintain support and collaboration

With considerations around time, training and piloting and perhaps the establishment of 'digital champions' in departments, it should be possible to achieve positive results around improving practical assessment, reducing both lecturer and student workloads - while at the same time enhancing learning opportunities. With some of the inputs mentioned, it will be possible to achieve benefits in the learning and teaching environment of practical sessions (See Figure 6).

Figure 6: An overview of the potential benefits via the embedding of TEAM project reflections.



In summary, the TEAM project has been considered a success by all stakeholders within the four partner colleges, with several outputs generated and a peer network successfully established. The level of expertise in place now, provides a strong foundation for further embedding technologies in practical assessment strategies across programmes, improving both the learning experience and employability of our students.

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Appendix 1: Questions in the Student Baseline Analysis Survey

Please tick one option for each of the following questions.

1) **What do you think?**

	Strongly Agree	Agree	Neutral	Disa-gree	Strongly Disa-gree	Not Appli-cable
Practical learning is important for providing me with the skills to make me ‘work-place ready’.						
Practical learning provides me with the opportunity to apply theory to practice.						
I prepare in advance of the practical session						
I feel adequately prepared for my practical sessions						
I am provided with adequate instructions during the practical sessions						
I would be able to complete the practical session without the aid of step-by-step instruction						
When in practical sessions I would like to come up with my own questions to investigate.						

When in practical sessions I try to check my data to see if my results are reasonable.						
I reflect over topics covered in the practical sessions after they take place						
I would like to have more 'discovery' type labs (i.e. student designs method/procedure to perform)….normally it's “explain then experiment”…..this approach would be “experiment then explain”.						
I would like to do a project based practical set over a few weeks (student project performed over multiple sessions vs. different practical each week)						

(a) What part of practical work do you find the most beneficial to your learning?

(b) What part of practical work do you find the least beneficial to your learning?

(c) What specific advice would you give to help improve your learning experience in practical sessions?

2) Assessment

Assessment refers to various ways of evaluating students' learning. Please refer to this definition of assessment when completing the remainder of the survey.

	Strongl y Agree	Agree	Neutral	Disa-gree	Strongl y Disa-gree	Not Appli-cable
The number of practical assess-ments is about right						
The different types of assessment are appropriate						
I am usually given feedback on my progress in practical sessions.						
I would like the opportunity to dis-cuss my feedback with the asses-sors						
I always take on board the feed-back given and make appropriate changes for subsequent assess-ment						
When looking at corrected assess-ments, I read any written feedback given as well as the grade/score						
The practical mark accurately as-sesses my practical ability						
I prefer to be assessed on some-thing submitted at the end of the session						
Written feedback is useful to help me understand my progress						
I feel written reports are the best way of assessing my efforts in practical sessions						
I would like my class members (peers) to assess my performance in practical sessions (Peer-As-sessment)						
I would like the marks for peer as-sessment to count towards my final grade.						

I would like to assess myself in Practical Classes (self-assessment))						
I would like the marks for self assessment included towards my final grade						
I prefer not to write reports for every single practical session						

(a) In line with the last question in Section 2, list other alternatives you would like to be used for assessment of practical learning:

3) Technology Enhanced Assessment Methods

In recent times, technology/digital approaches have been implemented in the education arena. For example, Apps used for Quizzes in lectures (e.g Socrative), ePortfolio or electronic reporting used in place of paper reports (e.g. Mahara and LabArchive software) or integration of online videos to complement laboratory or clinical skill development (e.g. YouTube).

(a) Would you like to see more digital technologies being used for assessment in your Practical classes?

YES NO

(b) The following are examples of digital technologies that can be used in practical sessions. Please indicate if you have used them and if not whether you would like to ?

TECHNOLOGY	HAVE USED		WOULD LIKE TO USE	WOULD NOT LIKE TO USE	NOT APPLICABLE
Socrative/Phone App Quizzes in practical sessions					
e Portfolios - to document your learning experiences					
Electronic/online lab notebooks (vs paper)					

Quizzes before the practical sessions to test foundations of concepts					
Use Apps for data collection/entry in practical sessions					
Virtual laboratory/practical sessions					
Audio feedback (e mailed to you)					
Submission of video practical reports / Screencasts instead of written reports					
Pre-practical videos (to view before practical session)					
Online discussion forum opportunities					
Online tests (vs. written reports)					

(c) If you would like to use, please list some examples of digital technologies that you would like to see being used for assessment in Practical classes

4) Choose AT LEAST two of the resources you ticked YES/LIKE and describe why you think they are important.

5) Any additional comments?

Appendix 2: Evaluation Focus Group Questions

Student Focus Group: Guiding questions

- Describe the technology you interacted with during the TEAM project?
    - Electronic lab notebooks (LabArchives)
    - Electronic lab notebooks (OneNote)
    - ePortfolios
    - Moodle/Blackboard Lab Submissions
    - Digital Feedback (which platform?)
        - Screencast
        - Audio 'clip?'
    - Rubrics
    - Pre-practical videos/pre-clinical skills video
    - Online quizzes
    - In class quizzes using Class response system eg
        - Clickers
        - Plickers
        - Socrative
        - Nearpod
    - Video Assessment

- How did you feel about performing aspects of your practicals/clinical skills session with [insert technology]?
- Did you find the use of [insert technology] enhanced your experience of practical/clinical skill sessions or elements of the assessment process?
    - If yes, why?
    - If no, why?
- How did the [insert technology] you engaged with compare to previous experiences of practical /clinical skills sessions?
- Would you like the module to maintain elements of the [insert technology] in the future (or other modules to begin using it)?
- How did [insert technology] make you feel about your work and practical /clinical skills sessions?
- Do you feel the [insert technology] improved your experience of practical/clinical skills sessions?
- Do you feel the [insert technology] improved your preparation for practical/clinical skills sessions?
- Do you feel the [insert technology] improved your understanding of a topic before you commenced a practical /clinical skills sessions?
- Did you have an opportunity to clarify the feedback received via [insert technology]?
- Did you have an opportunity to apply the feedback received via [insert technology] within the module or within another module?

- Do you have suggestions for improving the [insert technology] approach(es) utilised in this module?
- Do you have any other comments in relation to the [insert technology] utilised in this module?
- Can you please comments on the following with regard to the [insert technology] utilised in this module?
    - Strengths (what worked well)
    - Weaknesses (what didn't work well)
    - What could be improved?
- How useful was the [insert technology] utilised in this module?
- Did you experience any particular difficulties with the [insert technology] approach implemented in this project?
- What did you like most about using [insert technology] in this way?
- Can you please comment on the implementation of online quizzes in combination with the pre-practical/clinical skill videos?

Staff Focus Groups: Guiding Questions:

- Tell us about the assessment approach/technology you implemented/piloted? (Prompts – why did you choose this? Previous experience with it?)
- What were the advantages? Challenges?
- Did you observe any changes in your students' behaviour as a result of the approach/technology you implemented?'
- Did you gather feedback from your students? If so, what mechanisms did you use for this?
- How soon after the introduction of the assessment approach/technology you piloted did you acquire the feedback?
- Did you receive any specific feedback of note from your student group?
- What was the impact on your practice? (Prompts – has your view changed on (i) technology? (ii) feedback?)
- How could this be developed? (Prompts -what would you do differently? What would you advise someone else?)
- Do you intend to use this approach again or develop it further? (Prompts – why? Why not?)
- What recommendations do you have for enhancing assessment of practical with digital technologies going forward?
- From your participation in the TEAM project, what recommendations do you have for someone wishing to introduce digital approaches for assessment of practical sessions?
- What values do you think that these technologies would add to the students in making them job-place ready? (A link to the Industry)
- How satisfied are you with the training received for the technology you implemented?
- What worked well and not so well, and why?
- What was the most useful thing you learned by participating in the project?