



TBL Assessments

Faculty: Medicine
Department: School of Medicine
Module name: Clinical Science Integrative Cases (CSI)
Degree: MBBS
Level: Undergraduate (pre-clinical) Phase 1 (years 1-3)
Approximate number of students: 400 per year
Duration: approximately 2 hours (iRAT, tRAT, tAPP)
Module ECTS: 10 (per year)
Module type: Core
Insights colour key

Educational Developer

Inclusivity

Learning Designer

Registry

Careers

TBL is a more realistic fusion of assessment as that's what students are going to have to move towards as they work in teams in pretty much every industry they go into. Embedding elements of reflection so that students start to understand how they worked as a team and how those relationships could be enhanced and how to deal with disagreements.

Assessment overview

Programmatic assessments are delivered throughout the academic year alongside teaching, combining case-based learning methodology with [team-based-learning \(TBL\)](#) and individual assessments. TBL assessments consist of iRAT (individual Readiness Assurance Test), tRAT (team Readiness Assurance Test), and team Application (tAPP) exercises respectively. TBL assessments follow on from in class case-based learning sessions. The assessments are invigilated and delivered in-person electronically. Students in groups of five or six are given a number of single best answer questions relating to content delivered during the case based learning sessions and answer questions individually, then review the same questions as a team. These assessments are known as iRAT (individual Readiness Assurance Test), tRAT (team Readiness Assurance Test), and team Application (tAPP) respectively.

There are a total of four cases each term. Teaching is delivered for each individual case while the iRAT and tRAT assessments are delivered in pairs of cases. So, the first iRAT/tRAT of the term is based on the first and second taught cases, and the second iRAT/tRAT is based on the third and fourth taught cases. The tAPP relates to content taught across the four cases of the term but can incorporate new material that students need to process during the assessment.

Design Decisions

Rationale for TBL Assessments

The previous Problem-Based-Learning (PBL) course that ran for years suffered from high level of disengagement from students, and, if the team wanted to maintain aspects of PBL, there was a need to “re-invent” it in a way that students would start taking it seriously - integrating assessments into the teaching module seemed a clear way to do this.

The choice of delivering the module as TBL came from the need to assess team-working skills more effectively. Many high achieving students, while well-versed in medical knowledge, would fall short of working effectively in a team, which is an essential skill for doctors in a clinical environment. TBL had also been historically successfully used to encourage teamwork in BSc Biomedical Science and BSc Pharmacology students.

There was particular interest in the tAPP segment, as it has usually not been done very well. There was a need to create a challenging tAPP that encouraged better engagement and [team-working skills from students](#).

TBL has been shown to have positive impact on how students view teamwork and collaborative learning (Koles et al., 2005) and is an effective method for preparing students to conduct collaborative project work (Greetham & Ippolito, 2018). In addition, there is evidence of high engagement (Haidet, O'Malley & Richards, 2002) and positive feedback from learners (Parmalee et al., 2012; Zgheib, Simaan & Sabra, 2010) and faculty (Conway, Johnson & Ripley, 2010). TBL has also shown to be effective in enabling learners to identify gaps in their knowledge and improve their understanding (Behling et al., 2017). Colleagues can find out more about TBL via this [workshop](#).

Interviewee: Chris John (Reader in Pharmacology) and Agata Sadza (Head of Technology Enhanced Education)



Rationale for electronic delivery and software used

Electronic delivery of assessments using Learning Activity Management System (LAMS) software provides real-time data as students go through the assessment. Electronic assessments also allow for automated marking of the iRAT and tRAT segment, which is important considering the huge undergraduate cohorts in Medicine of about 400 students per academic year.

The assessment is run on-campus digitally using LAMS software with in-person invigilation. The LAMS software is an open-source learning design system for designing, managing, and delivering online collaborative learning activities. LAMS provides the ability to receive live data from student submissions, individually (iRAT) or as a group (tRAT, tAPP). LAMS therefore lends itself well to the tRAT and tAPP components of the assessment, where teamwork between students is heavily encouraged.

The flexibility that LAMS provides makes it preferable over other exam software. For one, the teacher or examiner has full control over the session and how students progress through the sequence of tasks; examiners may run an examination session with Single Best Answer (SBA) components, whereas a teacher can run their teaching session with an activity involving file submission, for example. They can also stop them at a specific activity, important for teaching sessions where thorough explanations or answering student's questions would be common. As this module's sessions are unique in that they merge both individual and team-based assessments together, LAMS's flexibility is important as it allows for a straightforward setup process that would simply not be possible (or at least much more difficult to do) on most other standard exam-based software available.

LAMS delivers real-time data to the examiner on student performance down to the individual question; examiners can use this to monitor where individual students are along the tasks, how much time they are spending on each task, when they started, finished, and of course what questions they are getting right and wrong. One further use of this data is to help meld and shape future sessions; if a question is only answered correctly by 20% of students, for example, then the data may suggest the question is misleading or too difficult. Examiners can then investigate this

TBL Assessments

particular question, taking actions as necessary, as well as write future questions avoiding the same shortcomings. Data can also be exported to Excel, where it can be manipulated and analysed if needed. Both teaching and assessment aspects of the module via College-issued iPads and answer questions via the same medium. Sessions are sometimes run in separate rooms, due to restrictions on room capacity - this is not an issue when the session is run online. Overall, digital delivery of the module is favourable over traditional methods (such as use of pen and paper) due to the large cohorts and the continuity of the module over three years.

Question design

The iRAT and tRAT assessments consist of Single Best Answer (SBA) questions. In the iRAT, questions are designed to link more closely to the actual clinical and scientific teaching that students receive in the module. During the tRAT, student groups work together to determine consensus answers for the same questions.

iRA/ tRAT – these questions are typically MCQs or SBAs and should test students understanding of key concepts found within the pre-reading/pre-session material.

The tAPP focuses largely on developing team-working skills and important skills required of future clinician scientist. The [question design](#) is therefore much broader and can be condensed into three main categories: data interpretation, infographics, and more complex clinical cases. Past examples of these have included designing a poster on long COVID ([infographic – see an example of a case study here](#)) or going through a challenging condition such as Alzheimer's disease or diabetes, from listing their risk factors to explaining the diagnosis to a lay patient empathetically.

The tAPP questions are particularly challenging and difficult, as they are designed to push students to complete tasks they would not have otherwise been able to on their own. The teamwork aspect allows questions to be complex, layered and less straightforward, with multiple ways to approach the question. With a time constraint of roughly 75 minutes, students tend to delegate tasks to members of the group in order to tackle such broad questions,



TBL Assessments

With any type of assessment it is important that the students understand what they are expected to do and this is also the case with any kind of group work. It is crucial to outline to students how the team is expected to work together, especially in environments where students need to work under time pressure. Getting students to negotiate ground rules can be helpful.

Explaining the rationale for TBL and associated assessments can be helpful when preparing students for working in groups of a TBL module. Some teachers incorporate peer feedback into the TBL process but as outlined in the 'Feedback arrangements' section, the logistics of this need to be considered, including how to engage students with this process.

Assessment design that allows students to build up the necessary skills that they can take forward can facilitate student learning. The main consideration is to ensure that the same task is not (in effect) assessed twice as part of a different module at a later stage; the nature and purpose of each assessment at each stage has to be sufficiently discrete to ensure that students are building / progressing on what they have done previously and not simply replicating it.

further encouraging teamwork as designed.

So far, new questions have been written for every assessment. Questions have not been re-used for any year.

Alignment with other assessments and the programme/module

The module is constructed as a collaborative process between other modules. It is intended to connect content-wise with other parts of the curriculum so that students have a consistent knowledge base and understand what and why they are being taught the content in a team-working scenario. For example, all of the cases have an associated case video, in which doctor-patient interactions are recorded with recruited actors. The specifics of the doctor-patient interactions are constructed with feedback from a range of staff involved across the curriculum to make them as realistic as possible.

Some of the program level Intended Learning Outcomes have a heavy team-working aspect. The ability to work in a team is heavily weaved into this module's specification and thus lends itself to these ILOs well. In the past it has fallen on the Professional Values and Behaviours Team (PVBT) to generate sessions around team working, but these had poor student engagement as mentioned before, meaning the team-working program level ILOs were often overlooked. The CSI module has found success in delivering impactful teaching of these ILOs to students by emphasising the assessment segment of the module to students whilst maintaining the team-working aspect of the sessions that the PVBT previously generated.

When introducing group work some consideration needs to be given to how students with specific learning needs can successfully participate in group interactions. All students involved should benefit from inclusive practice, this means that inclusivity considerations can be embedded within standard practice around preparing students for group work. This can be done through discussion around the allocation of roles and better understanding how others, including those with specific learning needs such as dyslexia, autism, dyspraxia etc learn and communicate. Individuals should be mindful of that and think about the delegation of individual tasks that are appropriate to what individuals can do. Therefore part of preparation for group work is considering how others can be mindful and empathetic towards other group members.

The module and module assessment continues over the three years of Phase 1. This means that students will develop a sense of consistency and familiarity with the assessment type, allowing for long-term progression of integrated knowledge from case-based learning in a team-based environment.

Practicalities

Preparing students for assessment



TBL Assessments

Originally, the first case of the term had a [formative assessment](#) (iRAT, tRAT, tAPP), but this was changed as it was decided that the first case was needed as part of the students' assessment portfolio. [To prepare students, there are formative TBL assessments in other modules that serve as preparatory work for CSI.](#) Within CSI, a number of formative cases are constructed and then delivered via a Teams call to allow students to practice in their groups and to facilitate the process of the real assessment in-person. These formative cases are predominantly tAPPS, most likely due to their complexity for both students to complete and for staff to construct and mark.

Marking arrangements

The iRAT and tRAT are auto-marked. The mark allocation is set up in a way that is as safe as possible for students; even if an individual student performed very poorly in the iRAT, the team-based component would protect them, making it virtually impossible for the student to fail the module. This is done to encourage the student to worry less about maximising marks for the module and allow more focus on building genuine team-working skills. That being said, for the tRAT, the marking system is quite punitive, with students being allowed four attempts to select the correct answer;

Marks for correct answers do appear to motivate students. Negative marking doesn't have to be used e.g., groups just achieve 0 for third or fourth attempts.

Correct Answer on " Attempt	Marks
First	+4
Second	+1
Third	-2
Fourth	-5

This is done intentionally to place students in a position where they take the assessment very seriously, in the interest of avoiding student disengagement as before with regards to group work.

The tAPP segment is marked by staff and is just as complex to mark as the questions themselves. Depending on the category of the tAPP, certain markers will be recruited. For example, data interpretation tAPPS tend to have a majority of researchers as markers, whereas more clinical tAPPS will have mostly clinicians as markers. For infographics tAPPS, the PBT team tend to generate most of the markers. Each of the three types of tAPP also have their own mark scheme ([please see an example of a tAPP here](#)).

There are usually more than eight individuals marking tAPPS, and they are all double marked. This requires a good level of co-ordination to manage. To help with this, markers have spent time marking together as a group, ironing out the mark scheme and discussing anything they are not sure about as they go along. This creates a supportive 'portal' that markers can come back to and ask questions between one another to make marking more consistent.



Feedback arrangements

For the iRAT and tRAT, students have a post-assessment 24-hour window where they are given the opportunity to challenge questions for any reason. The reasoning behind this is that writing questions for the assessment is challenging as it is not purely clinical and scientific content, thus there is an acceptance from staff that some questions may be written unintentionally ambiguously. Once all challenges are accrued, the module staff will sit down, work through the challenges and collectively decide on their outcome. They will then send a document back to students detailing the challenges, whether or they agree or disagree and the rationale behind said decision, and any amendments made to the marks. Typically, students that perform well, challenge very little and students who perform poorly challenge frequently. The system has so far worked well at picking up questions that were flawed and required removing.

The tAPP feedback, being marked manually, generally takes longer. It is typically a 2 week turnaround. So far, feedback is provided as a 'mix-and-match' of a large document sent to the cohort detailing what was done well, what needed improvement, etc. and individualised feedback from markers to the groups. The current issue with individualised feedback is that it can result in inconsistent feedback provided amongst different groups, so ideally future feedback would consist of solely a large document compiling and detailing the performance of the cohort.

The decision was made for peer moderation to not be added to this module, for the main reason that the entire process is logistically intensive with little return. In the past with other modules that had peer moderation, most groups decided unanimously to give each other top marks. If not, it was often the loudest member who acquired the top marks, which is not necessarily a fair representation. Although dysfunctional groups could occasionally be identified, in the case of CSI it is not worth the effort of organising peer moderation for 400 students in each of the three years. [Watch this video on peer assessment.](#)

Management of the process

The module is managed by leads and fellows with one Science Lead (interviewee), one Clinical Lead,

TBL Assessments

one Science Fellow and one Clinical Fellow. This has largely been enough to co-ordinate the module and assessments, however there is a reliance on the broad knowledge and skill base of the leads to co-ordinate and deliver a high quality of assessments, as well as the collaborative and collegiate nature of the faculty to create content that is correct and consistent with the rest of the curriculum.

In a typical in-person session, there are five to six people who assist in delivering the content to students. These will be clinicians (i.e. medical practitioners), scientists (i.e. staff members involved in scientific research) etc. to encourage a range of perspectives for better delivery of content to students. In the past, TBL sessions have been run by tutors who were not able to answer all of the medical students' questions due to lack of in-depth knowledge in that certain section of science. Having clinicians and scientists in the room to assist in delivering sessions rectifies this as they are a knowledgeable resource that can be consulted by students.

Online adaptations

During Covid the module and assessments were delivered online. Student groups were placed in breakout rooms with tutors invigilating by moving in and out of breakout rooms. Overall, student performance did not change, but student behaviour did change.

Regarding student performance, questions for the online adaptation were constructed to be just as challenging as in-person sessions. Students responded well and mean performance didn't change on-campus versus online. However, Teams allowed students to turn off their cameras and microphones, which many of them did, allowing for student disengagement in groups. Tutors going through breakout rooms would try to discourage this, but it is far less efficient than doing so in-person. Considering that peer moderation was not included in this module, assessing the difference that this online adaptation made to developing and encouraging teamwork behaviour versus on campus is difficult.

Student perspective

The student view of TBL is generally positive. They recognise that iRAT can be beneficial for testing their own understanding without any other help which



is then taken further in the tRAT, to allow for good discussions and exploration of different perspectives. There is a recognition of this way of learning being linked to real life practice in MDT (multidisciplinary) meetings where you are expected to express your opinion which is then discussed further with others. The students recognised that the varied tAPPs were a lot more difficult to prepare for because there was never really a set way of going about things. What was required was a good knowledge of the topic overall.

The actual style of the CSI questions were thought to be quite difficult. The students felt that they were phrased in a way to “trip you up and trick you” - always twisting the words a bit which resulted in uncertainty. That’s what led to a lot of challenges being sent to the CSI team and resulted in 3 (out of 10) questions removed for one of the assessments. There was a feeling of questions lacking clarity and that they were not really testing the knowledge, but testing students’ ability to pick up on those tricks.

There also seemed to be a lot of disparity between the groups. With some groups having 5 members and some seven. This had impact on groupwork. When it came to doing the tAPP tasks, smaller groups would often struggle because of less people working in a time pressure environment.

As CSI mainly happened online over zoom for some students, group participation was uneven. In some cases, unless group members were explicitly prompted, they would not contribute much.

Advantages of the assessment type

- Students often question why they learn certain pieces of clinical and scientific knowledge in the curriculum. This assessment helps them to understand that as the knowledge is integrated in realistic cases;
- The teamwork segment allows students to be challenged at a high level, and complete tasks that are clinically relevant. Students therefore engage with a lot of highly clinical material that they wouldn’t necessarily come across in the rest of the curriculum;
- Team working is an essential skill in the medical profession and develops clearly in medical students with this module assessment style;
- Students are well accustomed to digital

TBL Assessments

assessments. Even some traditional exams in other modules are done with college provided iPads rather than pen and paper, so the digital setup of CSI works well with students;

- The running of the module online is easier for everyone as everything is stored securely, easy to access and easy to work with;
- Digital assessments allow for unprecedented instant access to various data that can be exported, manipulated, processed, and used for various other purposes;
- The teamworking elements are an authentic representation of what students will be doing in professional world;
- It’s a method that generates higher student engagement and therefore can have a positive impact on student learning.

Limitations of the assessment type

- All marking comes at the end of term (Christmas, Easter, summer). This leaves a large volume of marking that needs to be done in a comparatively short space of time. Coupled with the complex nature of tAPP marking, this can be a lot of pressure for markers;
- Feedback is currently inconsistently delivered between individualised feedback and global feedback given in one document. A consistent method of feedback needs to be decided on and delivered;
- Generating the assessment needed at the level needed is a demanding task. The assessment style requires experienced leads with broad knowledge and skill base to deliver consistent, high quality assessments term after term;
- Writing questions for such an integrated assessment type is difficult and without careful attention it is all too easy to create material that does not work as well as it should. Some topics may not lend themselves well to SBAs, e.g. speaking to an Alzheimer’s patient, or delivering bad news. The module is still relatively new and there is a possibility that as the assessment type ages, writing new original questions may become increasingly difficult;
- Most of the time, the technology works exactly as expected, but sometimes issues arise which need to be managed. Occasionally, login issues occur where servers take a long time to respond. This is most likely due to a large number of students



(approximately 360) logging in at the same time – a self-resolving issue which would just require patience. During assessment, a student’s iPad may freeze and disrupt their progress, but a quick refresh of the page would most likely sort the issue. A typical problem would be Wi-Fi connection issues, where the college Wi-Fi fails on the whole, and one would need to wait for routers to restart and work again. Such an issue is difficult to mitigate against, especially when one is not in charge of its infrastructure.

Advice for implementation

- The module must be properly resourced with the right staff; having leads with broad medical knowledge and skill base is essential. These leads need to be supported with a good team; minimum two leads two fellows for module team.
- Leads need to be able to handle the logistical intensity of the module; CSI is 3 years of constant teaching and assessment delivery alongside each other to 400 students in fixed groups, so it never stops.
- By-and-large, the technical issues are very small and have easy solutions. Regardless, for summative assessments, it is useful to provide information to both invigilators and students on how to troubleshoot the typical problems that arise;
- The teams should consult the digital team once they know what format their assessment is going to be and what it will look like. The role of the digital learning team is to advise on the best platforms and the optimal setups for their style of assessment, to show how to run assessments best and to train examiners and teachers on how to use the system optimally. If other colleagues have had experience with running similar assessments in the past, the digital learning team will put them in contact with the new assessment leads to facilitate the design of the new assessment;
- This case study outlines how all elements of TBL and associated assessment have been implemented. Teachers may decide to implement just parts of the TBL process depending on the aims and outcomes for a particular session or programme e.g., just the iRAT and tRAT. Variations can also be made to the assessment including what elements are awarded marks and how

feedback is provided e.g., from tutors/peer/self or a combination thereof;

- Preparation for group work is crucial and should include considerations to the issues that students with specific learning needs might face in a team work situation. The teams should consider allocation of roles according to the strengths of its members especially for tAPP tasks that tend to be high pressure.

TBL Assessments

References

- Behling, K.C., Kim, R., Gentile, M., & Lopez, O. (2017). Does team-based learning improve performance in an infectious diseases course in a preclinical curriculum? *International Journal of Medical Education*, 8, 39–44.
- Conway SE, Johnson JL, Ripley TL. Integration of team-based learning strategies into a cardiovascular module. *Am J Pharm Educ*. 2010 Mar 10;74(2):35. doi: 10.5688/aj740235. PMID: 20414450; PMCID: PMC2856428.
- Greetham, M. & Ippolito, K. (2018) Instilling collaborative and reflective practice in engineers: using a team-based learning strategy to prepare students for working in project teams, *Higher Education Pedagogies*, 3:1, 510-521, DOI: 10.1080/23752696.2018.1468224
- Haidet P, O’Malley KJ, Richards B. An initial experience with “team learning” in medical education. *Acad Med*. 2002 Jan;77(1):40-4. doi: 10.1097/00001888-200201000-00009. PMID: 11788321.
- Koles P, Nelson S, Stolfi A, Parmelee D, Destephen D. Active learning in a Year 2 pathology curriculum. *Med Educ*. 2005 Oct;39(10):1045-55. doi: 10.1111/j.1365-2929.2005.02248.x. PMID: 16178832.
- Parmelee D, Michaelsen LK, Cook S, Hudes PD. Team-based learning: a practical guide: AMEE guide no. 65. *Med Teach*. 2012;34(5):e275-87. doi: 10.3109/0142159X.2012.651179. Epub 2012 Apr 4. PMID: 22471941.
- Zgheib NK, Simaan JA, Sabra R. Using team-based learning to teach pharmacology to second year medical students improves student performance. *Med Teach*. 2010;32(2):130-5. doi: 10.3109/01421590903548521. PMID: 20163228.