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Managing Editor
Angela Rhead

Administrator
Vanessa Hall

Telephone
+44 (0)1782 734436

Email
jade@keele.ac.uk

Web
https://www.keele.ac.uk/kiite/publications/jade/

Address
KIITE, Claus Moser Building, Keele, ST5 5BG.

Article:

Evaluation of Online Team Based Learning: Staff and Student Perspectives

Authors

Mary Richardson, BSc Chemistry Graduate.
Sir John Talbot's School, Whitchurch, Shropshire

Daniela Plana (corresponding author), Lecturer in Chemical and Physical Science
School of Chemical and Physical Sciences, Keele University, Keele, ST5 5BG.

Contact

d.plana@keele.ac.uk

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Abstract

With the forced move online during the Covid19 pandemic, Keele chemistry programmes turned to Team Based Learning (TBL) as an active learning method that could be adapted to a virtual environment. TBL is a structured, collaborative form of learning where students work together to solve problems; it has been found effective in enhancing student performance and developing transferable skills. This study aimed to evaluate the perceptions of staff and students of online TBL, using anonymous questionnaires (students) and interviews (staff). Whilst both students and staff surveyed found online TBL more difficult than in-person, particularly in terms of communication; they also indicated it was the best online teaching form experienced during the pandemic. Key benefits identified were the highly structured nature of the method, its encouragement of peer-to-peer interaction and the real-time monitoring of student progress by staff during sessions.

Introduction and Context

Traditionally STEM subjects have been and continue to be taught primarily through lectures, however, numerous studies have shown that active learning improves student attainment and decreases failure rates; a meta-analysis of 255 studies by Freeman *et al.* showed that introduction of active learning methods in STEM subjects on average increased examination scores by 6%, whilst students in traditional lecture-led classes were 1.5 times more likely to fail than their active learning counterparts (Freeman *et al.* 2014). This should hardly be surprising to scientists who generally would understand and adhere to constructivist theories, where learners incorporate new knowledge by creating links between new information and existing knowledge frameworks (Bodner 1986; Taber 2000; Piaget 1950). Constructivist theory naturally leads to more effective learning occurring when active processes are engaged in by the learner (Bonwell and Eison 1991).

Team Based Learning (TBL) is an active learning strategy developed by Michaelsen *et al.* in order to encourage small group, active discussion within large cohorts in business courses (Michaelsen *et al.* 1982). TBL has been shown to increase students' knowledge and engagement; TBL is essentially a structured, small group, collaborative form of active learning where learners combine their knowledge to solve problems. It consists of three key stages: (1) *preparation*, which can consist of set readings, videos, lectures, etc.; (2) the *readiness assurance test* (RAT), which encompasses a set of multiple choice questions (MCQs) first done individually (individual RAT, iRAT) and then as a team (team RAT, tRAT), followed by an instructor intervention; and (3) *application activities*, where more complex tasks are performed through team discussion and debate (Hancock *et al.* 2017). A key feature of TBL is the immediate feedback teams obtain during the tRAT, traditionally through the use of a scratchcard coded with the correct answers to the MCQs; this aids student engagement and provides independence from the instructor. Some of the benefits of TBL, beyond its immediate effect in learning of a specific subject, are found in the development of transferable skills including communication, teamwork, collaboration, critical analysis and problem solving.

The Covid19 pandemic disrupted the education of over 1.7 billion students worldwide, forcing teachers to adapt their classes to remote learning quickly, without much choice or preparation; whilst distance learning has been happening for a very long time, the scale at which it was now needed and the motivation of students was quite significantly different – learners did not choose this method of learning, impacting self-motivation (Dietrich *et al.*, 2020; dos Santos Belmonte *et al.*, 2022).

When faced with a forced move online for the 2020/21 academic year, with only laboratory sessions taking place in person for the chemistry and medicinal chemistry undergraduate programmes at Keele, we wanted to encourage active learning and peer discussions. Over the last seven years, in Chemistry at Keele we had adapted and incorporated TBL throughout the curriculum, from foundation year through to masters level, from organic to physical chemistry (Capel *et al.* 2021), thus we naturally focused on TBL as a remote active learning method.

TBL was adapted to a virtual environment, using MS Teams as a platform. The individual MCQs in the iRAT were done prior to sessions through various online forms (*e.g.* KLE tests, MS Forms) and an online scratchcard was developed for the tRAT; the online scratchcard (essentially a website) was

embedded on MS Teams, allowing the teams to choose answers for the MCQs and obtain instantaneous feedback, analogous to the traditional paper-based cards (further descriptions have been presented by Capel *et al.* 2022). Each team was assigned a specific Teams channel with the embedded scratchcard and a shared PowerPoint file, which was used to work together on the application activities. The facilitator had view of all channels, thus could easily monitor each team's progress on the tRAT and application activities, providing guidance or joining discussions as needed.

The current study describes staff and student perspectives of online team based learning in the 2020/2021 academic year and makes some recommendations regarding active online learning strategies.

Methodology

A favourable ethical opinion was obtained from the School of Chemical and Physical Sciences Student Project Ethics Committee (SCPS SPEC) for this study, which was developed as Mary Richardson's MChem research project, supervised by Daniela Plana.

Students' perception of team based learning, and particularly online TBL, were probed using an anonymous online questionnaire distributed to Keele undergraduate chemistry and medicinal chemistry students in years 1 through 3 (FHEQ Levels 4-6) in the 2020/21 academic year. 33 responses were obtained of approximately 165 possible participants (~20%).

The questionnaires (see below) consisted mainly of closed questions (both Likert scale and yes/no questions), but included some open-ended questions that allowed students to comment on their overall experience of online TBL, of working within their teams and (if applicable) provide a comparison between in-person and online TBL. As experience of online TBL would likely be impacted by whether students had previous experience of the method in person, data analysis considered previous experience of in-person TBL as a key element, over other standard distinctions such as year of study; whilst all chemistry and medicinal chemistry students in Year 2 and 3 would have experienced TBL in person previously, Year 1 students would have had variable experience: most would not have come across it, but a not-insignificant portion of the cohort would have used it, through chemistry modules in Foundation Year at Keele.

Staff views were gathered through five semi-structured online interviews on MS Teams and pseudonyms were used through analysis to maintain anonymity; staff interviewed all facilitated TBL sessions in the Keele chemistry and medicinal chemistry programmes in the 2020/21 academic year.

Questionnaires and interviews were analysed using both quantitative and qualitative methods, the latter based on thematic analysis initially performed by Mary Richardson and independently validated by Daniela Plana.

Results and Discussion

To obtain a general idea of student perceptions of online TBL, we initially asked about their enjoyment of the sessions and how useful they found them. Interestingly, as seen in Figure 1, whilst just under half of the participants (47%) stated they enjoyed doing TBL, a large majority (73%) found them useful.

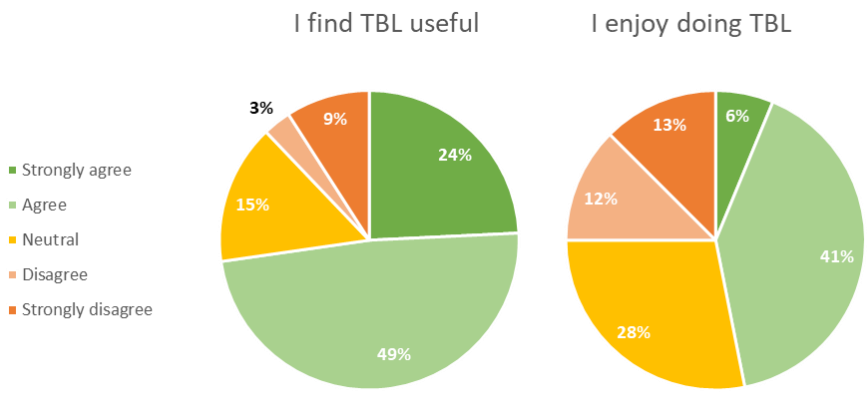

Figure 1. Student perceptions on enjoyment and usefulness of online TBL sessions

Whilst this generally agrees with previous studies that find students do not always enjoy TBL and more generally active/collaborative learning (Capel *et al.*, 2021), there is a significantly wider difference in this case between finding enjoyment and usefulness in TBL, which may be related to online learning being generally more of a struggle for students than in-person sessions. As one of the participants puts it, online TBL is:

> *"more difficult and frustrating than in person"*

In particular, communication was found to be difficult during online TBL sessions, both in terms of discussions with peers and communicating with staff. As Figure 2 shows, less than half of all participants agreed that they were able to effectively communicate with peers or staff during discussion. This seems to be in agreement with other studies regarding active online learning during the pandemic, which showed that key barriers were the limiting of students' interactions (Dietrich *et al.*, 2020; dos Santos Belmonte *et al.*, 2022).

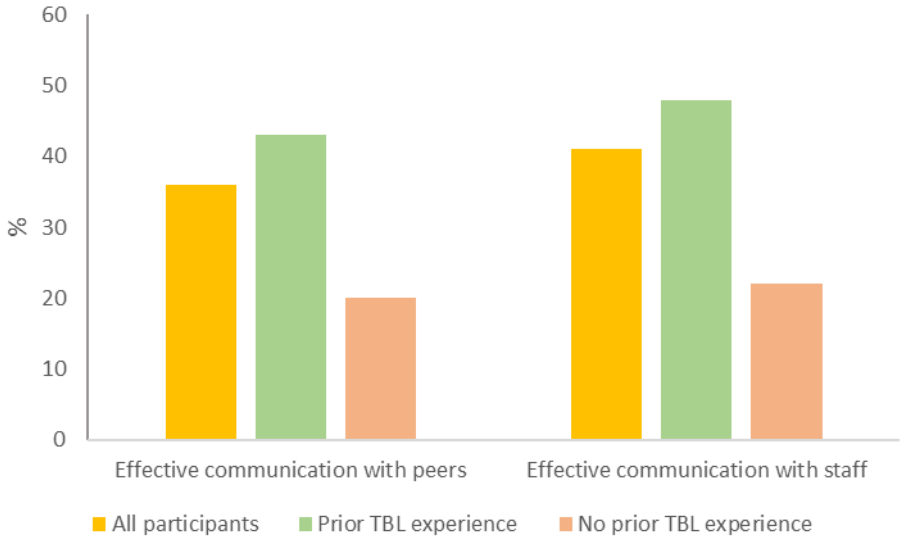

Figure 2. Student perceptions on effective communication with peers and staff during online TBL sessions

Interestingly, this effect was more pronounced in students with no prior in-person TBL experience; 20% (no prior TBL experience) compared to 43% (prior in-person TBL experience) stated communication with peers was effective, for example. This difference could well conflate two effects: the familiarity with the method and their classmates; the majority of students with prior TBL experience had known their classmates for at least a year prior to the move online, whilst those with

no experience are likely Year 1 students who may never have met their classmates in person, as most teaching took place online (the exception being laboratory classes, during which they worked individually and with significant social distancing). This is exemplified by comments from participants such as:

> *"I don't know anyone from my team hence it's a little awkward"*

> *"I have a difficultly talking to people I have never met but as the year has gone on it has become easier"*

Some of the issues highlighted in terms of communicating during team discussions included not knowing classmates, being unable to read body-language, non-engagement from teammates, the difficulty in using drawings and diagrams to support explanations or being able to see/check other's workings.

There was clearly a mix of opinions regarding the overall experience of online TBL sessions, with students stating that:

> *"It ranges from decent to downright dreadful depending on how engaged and involved my fellow team members are"*

A recent study of a similar adaptation of TBL to online environments during the pandemic highlight the importance of team dynamics, which support student performance and skill development; they advocate for support in terms of teambuilding, with time dedicated to discussions around team dynamics at the start of any course using TBL (Woodbury *et al.,* 2022).

Staff generally agreed that TBL lost some of its appeal online, particularly in terms of the individual touch of facilitators, as well as in the interaction of students with each other and with staff; views expressed are represented by the following quotes:

> *"… miss out on that personalised approach that you get in person"*

> *"… inhibition of the students to engage with each other and engage with the teacher"*

Additionally, some staff felt more remote to the session and the students, feeling somewhat alienated by not being able to see the students and gauge through their body language or expressions whether they were following the session and understanding the content. The decrease in immediate feedback from the students made the online TBL sessions more difficult than their in-person counterparts for the facilitators running them.

However, in considering the benefits of online TBL, most instructors agreed that the very structured format of TBL facilitates online student discussions and engagement, providing the best online learning experience for students during that academic year.

> *"… it's structured as it is in-situ and that that helps"*

> *"TBL in an online environment definitely facilitates the students being comfortable with discussion online"*

Additional benefits highlighted in comparing online TBL to other online teaching methods were for example the ability to monitor student progress in real time, both through the electronic scratchcard during the tRAT and using the shared PowerPoint slides during the application activities. The inability to gauge teams' progress during a session and for the instructor to move easily from one team to another when needed were highlighted as major issues in other virtual TBL adaptations (Woodbury *et al.*, 2022); whilst not as good as in person, as noted above, the methods chosen at Keele clearly provided an advantage to staff in real time monitoring and support. One caveat to both the structured nature of the method and monitoring in-session is that these take longer online than in-person, something that must be carefully considered in planning sessions; longer times required for similar activities online compared to in-person, as well as the need for well-timed breaks, has been commented on in studies regarding pandemic teaching (Sharp *et al.*, 2021).

In generally considering TBL as an online active learning method, most staff and students agreed that, despite its drawbacks when compared to in-person active learning, it was the best they encountered online during the 2020/21 academic year.

> *"Whilst worse than in person it's pretty much the best alternative we've got"* (Student)

> *"… many different versions of an online workshop this semester, and TBL is by far and away the one that works the best"* (Staff)

Summary and Recommendations

Overall, online TBL was well received by both staff and students, especially when compared to other online teaching methods, where the clear structure and real-time monitoring were highlighted as some of the key benefits. One particular benefit of the highly structured nature of TBL observed in the 2020/21 academic year was that it was easily accessible to staff with no prior TBL experience; in a moment of very sudden movement to online teaching, this was a clear advantage to staff having to come to terms with a very different way of teaching.

However, it was clear that the method suffered from comparisons to its in-person version, particularly in terms of inhibition and barriers in communication, both peer-to-peer and between staff and students. The first was especially exacerbated where students did not know each other well, with communication improving as the year progressed.

From this study some clear recommendations can be made to improve not only online TBL, but most forms of online active learning and some in-person.

- Communication is key, so any measures that can be put in place to improve it will improve the online learning experience.
- Teamwork and peer-to-peer discussion appears to be affected by how well students know each other and how comfortable they feel in talking, so induction activities that promote social interaction and encourage teambuilding may be of benefit at the start of online courses.
- Online learning and sessions require more time than the equivalent in-person, so this must be carefully considered in planning activities, including appropriate screen break times.
- Highly structured sessions facilitate online learning and interaction between students, so even where TBL is not being used, ensuring that a set structure is used will be of benefit in a virtual learning environment.

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Appendix: Data Collection Tools

A. Questionnaire For Student Participants

1. Have you done TBL in person before? (Link to appropriate section below)
   Yes / No

Please state whether you agree with the following statements as appropriate:

2. I find TBL useful.
   Strongly agree / Agree / Neither agree or disagree / Disagree / Strongly disagree

3. I enjoy doing TBL.
   Strongly agree / Agree / Neither agree or disagree / Disagree / Strongly disagree

4. Doing the iRAT before the session allows me to prepare for the TBL session. Strongly agree / Agree / Neither agree or disagree / Disagree / Strongly disagree

5. I am able to communicate effectively with my team during the online tRAT section.
   Strongly agree / Agree / Neither agree or disagree / Disagree / Strongly disagree

6. I am able to effectively communicate with staff when answering the tRAT questions in your team.
   Strongly agree / Agree / Neither agree or disagree / Disagree / Strongly disagree

7. I am able to effectively communicate with staff during the online whole class discussion of the tRAT.
   Strongly agree / Agree / Neither agree or disagree / Disagree / Strongly disagree

8. What is your overall experience of the RAT process during online TBL sessions?

Section for participants that have done TBL in person:

9. Do you prefer doing the iRAT before the TBL session?
   Yes / No

10. You are able to work as effectively with your team during the tRAT during an online TBL as you were during an in person TBL.
    Strongly agree / Agree / Neither agree or disagree / Disagree / Strongly disagree

11. How would you compare the online RAT process to the in person RAT process?

12. Do you have any other comments you would like to share regarding online TBL?

Section for participants that have only done TBL online:

13. Did you know/had you met any of your team before your first TBL session?
    Yes / No

14. If NO to the previous question: it is easy to work effectively as a team when you have not met the people in person.
    Strongly agree / Agree / Neither agree or disagree / Disagree / Strongly disagree
    Why?

15. Do you have any comments regarding the online RAT process in TBL?

B. Indicative Questions for Semi-Structured Interviews With Staff

1. Is it useful to have the iRAT answers before the session?
2. Is it helpful to have real time answers during the tRAT and why.
3. In your opinion are the tRAT questions answered faster during an online TBL session and why do you think that may be?
4. How has moving TBL sessions online affected your ability to communicate with students during the readiness assurance process (including instructor intervention)?
5. Do students seem more prepared for the tRAT having done the iRAT before the session?
6. What are your overall opinions on having TBL sessions online?