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## Adopting Team-Based Learning for In-Service Teachers: A Case Study

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# Adopting Team-Based Learning for In-Service Teachers: A Case Study

## **Abstract**

Team-based learning (TBL) is an instructional pedagogy that has gained recent popularity due to its effectiveness in disciplines such as medicine and business. However, TBL has not been widely adopted in teacher education based on reviews of research and practitioner based literature. The purpose of this case study was to assess the implementation and effectiveness of TBL in a Singapore teaching institute with thirty in-service teachers. Quantitative and qualitative data was collected from teachers about their experience learning through TBL. Research findings revealed that 1) teachers generally perceived TBL to be a positive experience, although several areas for improvement were suggested; 2) quality of scores through TBL was high, with team scores being significantly higher than individual scores. The findings from this study have the potential to guide the design of future TBL courses in education.

## **Keywords**

Team-Based Learning, Pedagogy, Teamwork, Teacher Education

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## Adopting Team-Based Learning for In-Service Teachers: A Case Study

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Team-based learning (TBL) is an instructional pedagogy that has gained recent popularity due to its effectiveness in disciplines such as medicine and business. However, TBL has not been widely adopted in teacher education based on reviews of research and practitioner based literature. The purpose of this case study was to assess the implementation and effectiveness of TBL in a Singapore teaching institute with thirty in-service teachers. Quantitative and qualitative data was collected from teachers about their experience learning through TBL. Research findings revealed that 1) teachers generally perceived TBL to be a positive experience, although several areas for improvement were suggested; 2) quality of scores through TBL was high, with team scores being significantly higher than individual scores. The findings from this study have the potential to guide the design of future TBL courses in education.

### INTRODUCTION

Team-Based Learning (TBL) is an instructional approach designed to combine the principles of Problem-Based Learning, Student-Centred Instruction, and Constructivism. Popularized by Larry Michaelsen in the late 1970s, TBL first gained prominence in medical education as a framework to develop intern and resident doctors (McMahon, 2010). TBL has since been adopted throughout health sciences and business curricula, and more recently, in teacher training (Samad, 2015). TBL is a team-based, peer teaching strategy that focuses on fostering positive team dynamics through intra-team communication. TBL provides students with opportunities to expose inconsistencies between their current and new understanding in order to build new knowledge (Samad, 2015; Hrynychak & Betty, 2012). One of the values of TBL is that it can be used as a complete course framework strategy but is versatile enough to be effective when delivered as part of a hybrid design (Michaelsen & Sweet, 2008).

### Sequence of Team-Based Learning

A TBL sequence typically consists of three stages. The three stages can take place within a single course meeting or distributed over several sessions. These stages are student preparation, readiness assurance, and application. In the student preparation stage, students are provided learning resources to study individually before the TBL session. Students should review the materials prepared before coming to class. Upon arrival to class, the instructor proceeds with the readiness assurance tests. Students first complete the Individual Readiness Assurance Test (IRAT). The IRAT is a multiple-choice test assessing knowledge gained from the learning resources provided by the instructor. The IRAT is usually comprised of 10-15 questions and students are provided approximately 15 minutes to complete the assessment (McMahon, 2010). During the IRAT, students fill in an assessment form and, concurrently, copy their answers down on a separate document for later retrieval.

Following the IRAT, students proceed with the Team Readiness Assurance Test (TRAT) which takes place as soon as the time limit is up for the IRAT. The TRAT is comprised of the same multiple-choice questions but students complete the TRAT with teammates that have been pre-assigned. Individuals know which answers they provided for the IRAT and can discuss their responses with their teammates. The teams answer questions using a specially design scratch-off answer card. Once the teams complete the TRAT, they

are provided an opportunity to appeal any questions they believe to be unfair or ambiguous.

The IRAT and the TRAT are designed to assess student readiness before advancing to the higher level problem-solving required in the application stage. The application stage requires students to apply the knowledge learned in problem-based scenarios. This stage involves intra-team discussion and larger class discussions, with the emphasis on the application of knowledge as opposed to simple rote learning. Application exercises (AE) are provided during this stage which focus on students working together to solve a common problem. For example, if the unit is focused on learning more about social media, the IRAT and TRAT may cover definitions, types of social media, and statistics about the use of social media today. The application exercises may have students come up with creative ways to use social media in a classroom, business, or specific industry.

### Principles of Team-Based Learning

In McMahon's (2010) analysis of TBL, he states four essential principles. The first principle is team formation and maintenance. Teams should be formed at the beginning of the course and members should stay together throughout the course. Instructors should be deliberate and thoughtful in team formation and ensure that members come from different knowledge base and backgrounds. The process of groups actualizing into efficient teams may be bumpy and require maintenance but this process should be worked out by the members themselves without much intervention from the instructor. This allows students to learn to work with each other instead of relying on themselves as individuals.

The second principle is that all students should be accountable for their contribution to the team. This crucial because students learn best when there is an immediate need and an appropriate incentive (McMahon, 2010). TBL holds students accountable through their individual grades and their contributions to the team score. To increase accountability, peer evaluation can also be strategically incorporated into parts of the course. A key to effective peer evaluation is facilitating a frank discussion with honest, constructive criticism given. Instructors should ensure that students understand the importance of honest peer evaluation by team members.

The third principle of TBL is the provision of real-time feedback to students. This is implemented through the use of scratch-off

answer cards during TRAT, where answers will signal to teams whether their interpretation of the concept was correct. Real-time feedback is crucial for the consolidation of learned knowledge and reinforces student learning by addressing small increments of the overall learning objectives. Corrections to misconceptions can be offered immediately by peers or the instructor to strengthen learned knowledge.

The fourth principle stated by McMahon (2010) is that team assignments in the application phase should promote both student learning and team development. Assignments and AE should be designed to require team interaction. This covers an important aspect of TBL – peer teaching. The assignment should not be able to be broken into individual assignments with each student covering one assignment; it is the peer teaching that drives team formation.

### Background for the study

The majority of the research on the effectiveness of TBL has been conducted in medical and business contexts. For example, Reinig et al. (2011) examined 137 students' attitudes and satisfaction towards a TBL course in upper division accounting. The authors found that students generally rated TBL positively and recognised its benefits to develop teamwork skills. A similar study was conducted by Chad (2012) who examined the first time use of TBL in a postgraduate marketing module in an Australia university. The author found that TBL had a positive influence on student engagement and offered opportunities for assisted learning. In a more rigorous study, Vasan et al. (2011) ran a longitudinal 5-year study comparing student performance of a TBL-based pre-clinical course and a lecture-based pre-clinical course. The authors found that student performance was not only higher in the TBL-based course but students also perceived TBL to be a motivator for team accountability and self-directed learning. Collectively, these researchers have demonstrated that TBL is an effective teaching method enable educators to offer students a more enhanced and stimulating learning experience.

Most recently, the first report of a longitudinal study of medical students taught using TBL was conducted by Zgheib et al. (2016). Based on a new curriculum, 90 TBL sessions were implemented in 2 years to 102 medical students to evaluate the long-term impact of TBL. The authors found sustained and cumulative improvement in teamwork and communication skills, professional, and personal development over time. This was the first study to demonstrate the long-term positive impact of TBL. Research has also branched out into evaluating 'modified' TBL classes, which retain core elements of TBL but incorporates other aspects of pedagogy that may be more suitable for its target audience. One such study was conducted by Huang et al. (2016), who examined the impact of modified TBL in an Ophthalmology Clerkship in China. The one-week clerkship included traditional lectures, gross anatomy, and a TBL module. The results revealed that 57.65% of students agreed that TBL was helpful and that TRAT scores were significantly higher than IRAT scores for all teams.

Despite the prolific number of studies demonstrating the effectiveness of TBL, there are still some barriers preventing a more comprehensive view of this pedagogy. For example, many studies rely on surveys to collect quantitative data on students' TBL experience (e.g. Frame et al., 2015; Reinig et al., 2011; Cho et al., 2010), with fewer studies focusing on qualitative data (e.g.

Sutherland et al., 2013; Chad, 2012). In addition to this, there is scant research on the challenges faced by instructors during TBL courses. In our case study, we adopted a triangulation strategy where we analysed both quantitative and qualitative data to get a more comprehensive understanding of TBL implementation.

Another reason to conduct this study was due to past reliance on traditional pedagogies in Singapore. Such pedagogies are predominantly teacher-led and lecture-based. One negative consequence of such pedagogies is that "in the traditional classroom learning environment, students are simply passive" (as cited in Singteach, 2010, p. 7). Chhem (2000) reported that the education system in Singapore was heavily based on Spoon-Feeding, where the teacher acted as a knowledge dispenser for passive students (Chhem, 2000). While such spoon-feeding used to be common in Singapore, schools have begun to adopt pedagogies that require more active participation and interaction from students. Examples of these include the use of blended learning and flipped classrooms (Yang, 2015; NIE, 2010). Finally, a report on the history and future of TBL in Singapore suggests that TBL promotes and enables students to foster important 21st century skills in certain content areas (Compton, Cook, & Kamei, 2016). This study's goal to implement TBL represents a conscious effort to continue the trend of more active participation from students.

### METHOD

#### Teachers and course design

Thirty teachers enrolled in a course focused on the practical applications of technology in education (MSE 850: Technology for Engaging All Learners). The course explored the implications of using mobile technology for teaching all students regardless of content area, grade level, age, or ability. Course activities covered the theoretical underpinnings of technology adaptation and focused on practical solutions for teachers' personal and professional implementation. The three-hour course was held in the evening one day per week for thirteen consecutive weeks and was taught by one instructor who was assisted by one teaching assistant. The age range of the teachers in the class was 24 to 59 years old although the majority of the teachers were between 30 to 39 years of age. Teachers were selectively pre-grouped into teams of five or six. Teachers were grouped into teams according to content area taught, gender, and ethnicity.

The course was divided into four themes of technology use: (1) The Reality of Mobile Technology, (2) Communication and Connection, (3) Content Curation, and (4) Assessment. Each theme took place for three weeks of the class with one week left for the introductory lesson. In the first week of each theme, the IRAT and TRAT would take place alongside lecture or discussion activities. AE would take place in the second and third weeks. The goal of this case study was to evaluate the effectiveness of implementing TBL in a Singaporean context through teachers' course performance and their individual perceptions of the TBL experience.

#### Grading Process

The grading process for the course was based on five components. These were: (1) evidence of using ten important mobile tools (e.g. polling software, backchannel discussions, etc.), (2) IRAT score, (3) TRAT score, (4) AE score, and (5) individual blog developed by teachers showcasing their learning in the course. The grading

process was designed to consist of a mix of both TBL and non-TBL assessments. Originally, a ranking system was introduced to assess peer evaluation but was modified in consideration of teacher response.

The "Ten Tools to Know", which accounted for 20% of the overall grade, are ten tools that every educator should know about mobile tools and be able to use in class. The teachers' individual blog, which accounted for 20% of the overall grade, required them to describe a personal plan to implement technology into their academic work. The remaining 60% was dedicated to TBL assignments.

#### Procedure

On the first day of the course, teachers were given an introductory talk on TBL by an external TBL facilitator. The facilitator was one of the co-founders of the TBL initiatives in Singapore and has conducted several TBL boot camps in and out of the institute. The facilitator briefed teachers on the elements of TBL, benefits, and results from previous studies. After the introduction, teachers were divided into their pre-assigned groups.

Two weeks before each of the four themes, teachers were provided a link to access the learning resources for that theme in order to prepare for IRAT and TRAT. These resources included journal articles, website articles, blog pages, and online videos. The IRAT comprised of 10 to 15 multiple-choice questions (MCQs) which teachers had to complete individually. These MCQs were based on the learning resources provided. Questions were derived from the learning resources listed in Table 1. Google Forms was used to administer the IRAT and Flubaroo was used to grade the IRAT. Teachers were given 15 minutes to complete all questions. Additional time was given to teachers with a documented disability when requested. A timer projected on a screen in the front of the class was used to mark the start and end of each IRAT. No additional time was given for later-comers.

Theme	Resources Provided	Number of IRAT Questions
The Reality of Mobile Technology	2 articles	11
Communication and Connection	4 videos on Youtube	10
Content Curation	3 articles 1 video on Youtube	13
Assessment	3 videos on Youtube 1 article on Wikipedia	11

The TRAT commenced immediately after IRAT. For the TRAT, teams at each table worked together to come to an agreement on each answer. The TRAT focused on immediate feedback and was assessed using the immediate-feedback assessment technique (IF-AT), through a self-scoring answer cards (see Figure 1). These cards serve as timely feedback and allow teachers to correct misconceptions immediately. On these cards, members scratch off one of the four options covered with opaque film to search for a star that indicated the correct answer. If the team found the star on their first try, they received full credit score of four points. If not, they would continue scratching until they find the correct

answer, but their score would be reduced with each unsuccessful scratch. This allows teams to receive partial credit for proximate knowledge (Michaelsen & Sweet, 2008).

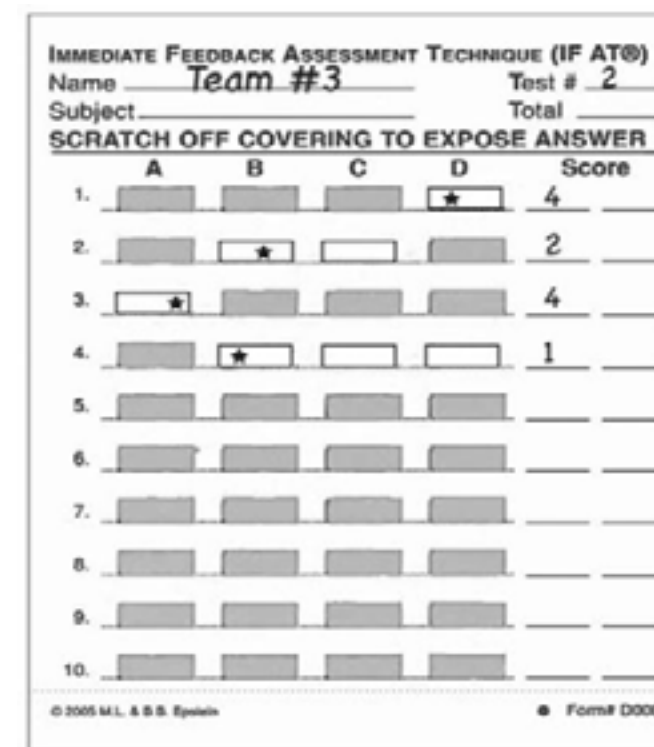


Figure 1. IF-AT scratch card for the teams.

After the TRAT was completed, the instructor went through each question and gave teams the opportunity to point out any questions they felt had a debatable answer. This was also referred to as the burning question stage. Any team that had their appeal accepted was awarded bonus points.

In the application phase, teams were presented with a series of problem-based scenarios based on the themes. The amount of time allocated to discuss answers depended on the complexity of the scenario. An example question was, "You have a student who has special learning needs. List and describe each of the features in a smartphone that can help in learning." The purpose of this example was to get teams to consider all students needs and discuss on the features of a smartphone that can fulfil those needs. All necessary resources, including flipcharts and markers, were provided.

#### Data Collection

Both quantitative and qualitative data were collected to establish a comprehensive understanding of the effectiveness of TBL implementation in our course. Quantitative data was collected through the TBL questionnaire which comprised of a demographics section and close-ended questions asking about teachers' experience of TBL.

The demographics section consisted of six items asking teachers on their gender, area of teaching, age, ethnicity, years of teaching, and number of technology courses taken. The body of the questionnaire consisted of questions asking teachers about their TBL experience. Statements were developed from a review of the literature with several being adapted from validated questionnaire surveys used in other studies (Frame et al., 2015). An example of

the statement was, "The use of TBL enhanced my learning experience in class". The statements were presented in a 5-point Likert scale format with a response of 5 indicating very strong agreement to a statement, and a response of 1 being a very strong disagreement. The questionnaire was peer-reviewed by the TBL facilitator who had designed TBL questionnaires in previous courses.

To collect more detailed responses from teachers, a focus group interview was conducted after the completion of all TBL activities. One teacher was randomly selected from each team totalling six participants. The interview lasted 60 minutes. Questions were designed to be an extension of the questionnaire statements asking about their TBL experience (See Figure 2). A total of seven questions including "Which part of the TBL did you learn the most" and "What did you like and not like about your experience of TBL" were presented. The interview was facilitated by the external TBL facilitator with an assistant.

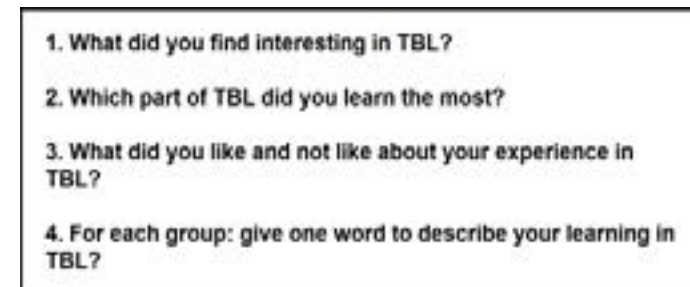


Figure 2. Example questions asked during the focus group discussion.

**Data analysis and coding**

Data was analysed descriptively and comparatively to understand student performance and perceptions towards TBL. To prepare data for comparison, an averaged IRAT score was first computed by taking the mean of teachers' IRAT across all four IRAT sessions. For teachers who were late and missed one (or more) IRAT and had a valid excuse (e.g. medical certificate), their averaged IRAT score was computed by taking the mean of their IRAT scores for the sessions they attended. For example, a teacher who completed the first three IRATs but missed the final IRAT due to a valid reason would have their averaged IRAT computed based on average of the three IRAT he/she completed. However, teachers who missed an IRAT without a valid reason, would be given a score of zero for that particular IRAT. These measures were implemented to ensure more control for teacher performance. A paired samples t-test and Pearson correlation was performed to compare between individual and team performance and to assess the existence of linear relationship between each component of TBL. Descriptive statistics including frequencies, mean scores, percentages, and standard deviations was generated based off data from the TBL questionnaire. The Statistical Package for the Social Sciences (SPSS version 20.0) was used for all statistical analyses.

Focus group responses were transcribed verbatim from the digital recordings. The research assistant who was not involved in the focus group interview examined the distinct statements and grouped them into four unique themes. The principle investigator then checked the degree of consistency across the statements in each theme. After discussion, there was 100% agreement on the statement-theme fit and the consistency of statements within each theme.

In the final stage, the research assistant constructed a definition

for each theme and selected example statements that were most representative of that theme. The fit between statement and theme as well as the definitions were given a final check by the principle investigator. Following a discussion, both the research assistant and principle investigator reached 100% agreement on the statement-theme fit and definition.

**RESULTS**  
**Quantitative Analysis**

A paired samples t-test with an alpha of .05 was used to compare the mean performance scores between IRAT (M = 68.72, SD = 13.10) and TRAT (M = 75.78, SD = 14.47) scores throughout the five TBL sessions. On average, TRAT scores were 7.05 points higher than IRAT scores (CI = 1.83, 12.29) than IRAT scores. This difference was statistically significant,  $t(29) = 2.76, p < .01$ . Figure 3 shows a bar chart comparing the mean scores between IRAT and TRAT.

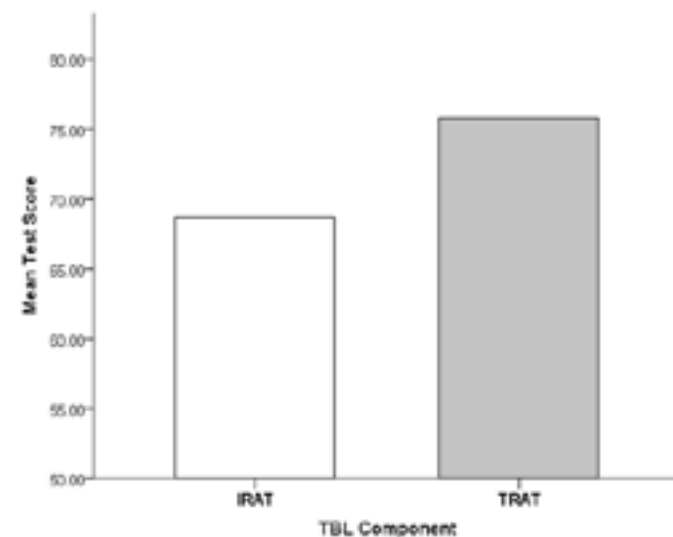


Figure 3. Mean test scores of teachers as a function of the TBL component.

To assess the size and direction of the linear relationship between the variables IRAT, TRAT, AE, and Final Course Grade (FCG), a bivariate Pearson's product-moment correlation coefficient was calculated. There was a strong positive correlation between IRAT and FCG,  $r(28) = .495, p = .005$ . There was an even stronger positive correlation between TRAT and FCG,  $r(28) = .609, p < .001$ . Interestingly, the relationship between AE and FCG was not significant (see Table 2).

The frequency, percentages of responses to the statements, and the mean response to each statement are displayed in Table 3. The mean scores for the statements generally indicate a positive view towards TBL as 9 out of 11 items have a mean response of 4.00 or higher, with mean responses of the remaining responses between 3.5 and 4.0. Teachers' perception of TBL in terms of team learning was the most positive, with 90.3% either agreeing or strongly agreeing that learning through small teams enhanced their learning. 71% of teachers either agreed or strongly agreed that TBL improved their interpersonal and problem solving skills. Teachers also highly favoured TBL, as 83.9% prefer TBL over traditional lectures, and 80.6% would recommend TBL in future courses. Overall, 87.1% of teachers were very satisfied with the TBL experience.

**TABLE 2.** Correlations between IRAT, TRAT, AE, and FCG.

		Correlations			
		IRAT	TRAT	AE	Final
IRAT	Pearson Correlation	1	.488**	.114	.495**
	Sig. (2-tailed)		.006	.548	.005
	N	30	30	30	30
TRAT	Pearson Correlation	.488**	1	.177	.609**
	Sig. (2-tailed)	.006		.350	.000
	N	30	30	30	30
AE	Pearson Correlation	.114	.177	1	.349
	Sig. (2-tailed)	.548	.350		.059
	N	30	30	30	30
FCG	Pearson Correlation	.495**	.609**	.349	1
	Sig. (2-tailed)	.005	.000	.059	
	N	30	30	30	30

Note: \*\* = Correlation is significant at the 0.01 level (2-tailed).

**Quantitative Analysis**

Overall, the four themes that emerged from teachers' overall experience of TBL were: most interesting, most helpful, peer evaluation through ranking, and punctuality. The percentage of teachers that contributed their thoughts to each theme was included, with a higher percentage representing more teachers voicing out on that theme (see Table 4).

The most interesting aspect of TBL was the exchanging of ideas in discussions. Teachers thought that every member had a different interpretation of the questions and that they could apply this interactive pedagogy in their own classrooms. They also enjoyed the burning questions as it provided opportunities to clarify any questions with ambiguous answers.

Teachers commented that the aspects of TBL that were most helpful to their learning was application exercises and team readiness discussions. Teachers liked application exercises because the quality of answers they produced had practical value. Through the intra- and inter-team discussions, teachers were able to remember concepts as they had already discussed them. Overall, words that teachers used to describe their overall learning from TBL were: "Engaged", "Beneficial", and "Sustainability".

Peer ranking of each team members' contribution emerged as the most disliked part about TBL. Teachers felt that the ranking system could be unfair to teachers would could fail their module because of getting the lowest points and suggested to replace the ranking system with another form of peer evaluation.

Another aspect that teachers disliked was the requirement to be punctual for TBL sections, especially the IRAT that first takes place during classes. Teachers expressed dissatisfaction with the need to be punctual, as it was brought to attention that all teachers were part-time students. They had undertaken the module as part of their Masters' curriculum and had concurrent commitments (e.g. work, teaching) that would prevent them from being punctual all the time. Teachers pointed out that schedules may clash or unforeseen circumstances may arise from their commitments and these events may cause them to be late.

**Table 3.** Questionnaire statements and the means, percentages, and standard deviations of teachers' responses.

Statement	SD	D	N	A	SA	Mean ± std dev
TBL was a suitable instructional design for the course.	1 (3.2%)	1 (3.2%)	5 (16.1%)	11 (35.5%)	13 (41.9%)	4.10 ± 1.01
The use of TBL enhanced my learning experience in class.	1 (3.2%)	1 (3.2%)	2 (6.5%)	11 (35.5%)	16 (51.6%)	4.29 ± .97
The course was able to meet its learning objectives.	2 (6.5%)	0 (0.0%)	1 (3.2%)	4 (12.9%)	24 (77.4%)	4.55 ± 1.06
The use of TBL improved my interpersonal and group interaction skills.	1 (3.2%)	2 (6.5%)	6 (19.4%)	12 (38.7%)	10 (32.3%)	3.90 ± 1.04
The use of TBL improved my problem-solving skills.	2 (6.5%)	2 (6.5%)	5 (16.1%)	14 (45.2%)	8 (25.8%)	3.77 ± 1.12
The TBL activities encouraged me to think critically.	2 (6.5%)	1 (3.2%)	2 (6.5%)	14 (45.2%)	12 (38.7%)	4.06 ± 1.09
The use of TBL increased the extent of my usual classroom participation.	1 (3.2%)	2 (6.5%)	2 (6.5%)	12 (38.7%)	14 (45.2%)	4.16 ± 1.04
Learning through small teams improved my understanding of the course content.	1 (3.2%)	0 (0.0%)	2 (6.5%)	12 (38.7%)	16 (51.6%)	4.35 ± .88
Overall, I prefer TBL to traditional lectures.	1 (3.2%)	2 (6.5%)	2 (6.5%)	15 (48.4%)	11 (35.5%)	4.06 ± .10
I would recommend the use of TBL in future courses.	1 (3.2%)	1 (3.2%)	3 (9.7%)	13 (41.9%)	12 (38.7%)	4.13 ± .97
Overall, I am satisfied with the TBL experience.	1 (3.2%)	1 (3.2%)	2 (6.5%)	13 (41.9%)	14 (45.2%)	4.23 ± .96

Note: SD = Strongly Disagree; D = Disagree; N = Neither Agree nor Disagree; A = Agree; SA = Strongly Agree

**DISCUSSION**

Comparison of IRAT and TRAT performance revealed that mean TRAT scores were significantly higher than mean IRAT scores by 7.05 points. This result was expected and in line with the theoretical underpinnings of TBL, which state that TBL provides the depth of understanding that can only come from solving problems in teams that are too complex for any individual effort (Michaelsen & Sweet, 2008). Furthermore, this result is in line with previous studies that have found TRAT scores to be better than IRAT scores (Vasan et al., 2011; Cho et al., 2010), further providing evidence for the use of TBL in the Asian teaching context.

The strongest positive correlation was found between teachers' TRAT score and their FCG. There was also a positive correlation between IRAT scores and teachers' FCG, although not as strong. This

**Table 4.** The themes, definitions, percentage of teachers who responded, and most representative statements for each theme.

Theme	Definition	Percent of Teachers	Most Representative Comments
Most interesting	The aspect(s) of the course that teachers found to be the most interesting	50%	<ul style="list-style-type: none"> <li>•The discussions going on, exchanging of ideas, and discussing with group mates is what makes it interesting.</li> <li>•The idea of discussions is very interesting because we can relate it back to our classrooms teaching as well, so it is something very interactive.</li> </ul>
Most helpful	The aspect(s) of the course that teachers found to be most helpful for their overall learning	83%	<ul style="list-style-type: none"> <li>•Application exercises and team readiness</li> <li>•I really liked the application because no point learning all the theory without knowing how to apply in real life situation. So when the group shared...it was very enlightening.</li> <li>•We are able to remember most of the (materials) because we already discussed it.</li> </ul>
Peer evaluation through ranking	A remark that pertains to the dislike of the peer evaluation system	83%	<ul style="list-style-type: none"> <li>•I guess we are uncomfortable with it because as educators we have heard of extrinsic motivation versus intrinsic motivation. When you come up with a ranking system, it creates an extrinsic motivation for you to contribute, in a sense. Because you're worried that you will not be contributing enough. And I'm very uncomfortable with that.</li> </ul>
Punctuality	A remark that pertains to the dislike of the need to be sharply on time for classes	83%	<ul style="list-style-type: none"> <li>• Sometimes we are late because of school meetings and all that, so we will miss the IRAT and sometimes the TRAT we'll join halfway.</li> <li>•...because we are part-time (students), we will always encounter the timing part...the commitment...</li> <li>• It is not our intention to be late. We did try to justify that we are not full-time students with intentions to be away; we are working adults who were forced to attend meetings.</li> </ul>

supports the validity of IRAT and TRAT, two core components of TBL, for learning. More crucially, the TRAT-FCG correlation reinforces the importance of the 'team' in TBL.

Interestingly, AE scores were not significantly correlated to FCG. This result could be attributed to the varied nature of tasks that were set for AE. The AE in this study included, among other items, discussion questions, building of a resource repository, and building programs. This caused variation in teachers' AE scores as a teacher with strong performances in IRAT and TRAT could have scored lower in their AE but still received a high overall grade.

Overall, the implementation of TBL in this in-training teacher module was well-received. In 9 out of the 11 items we asked on teachers' experience of TBL, there was a mean response of 4 out of the possible 5. Teachers were most satisfied with the experience of learning through small teams and would promote and recommend TBL over traditional lectures in future modules. Overall, 87.1% of teachers responded that they were satisfied with the TBL experience. These results provide further support for the use of TBL when compared to more traditional and lecture-based pedagogies.

Results from the focus group data supported teachers' satisfaction that were revealed from the TBL questionnaire. Most teachers praised the unique method of learning through small group discussions as the exchange of ideas and being able to interact with other members made learning very interesting. In addition, teachers commented that learning through TBL was more beneficial for them because they were able to retain more of the learning materials. These comments correspond to the teachers' high overall individual FCG and the strong positive correlation between TRAT and FES.

Responses from the qualitative analysis enable us to understand which aspects of TBL teachers liked or disliked. Despite liking elements of team learning such as TRAT, burning questions, and application exercises, teachers also pointed out several dislikes. The main dislike was peer evaluation through a ranking system. The course utilised a ranking system which was met with unanimous disapproval from teachers. Teachers felt that the ranking system was to some extent "unfair" and could contribute to certain teachers failing the module if they received the lowest rank.

Overall, the reactions towards peer evaluation in our study highlights another layer of TBL that can be explored. We were posed with the difficult problem of teachers not favouring the way individual accountability was reinforced. The ranking of teammates as a method of peer evaluation has not received much attention in literature. Typically, peer evaluation in TBL is conducted by having students fill up peer evaluation forms to assess members (Simonson, S. R., 2014; Moye et al., 2012). The purpose of using a ranking system in our study was to create differentiation in teacher effort and award teachers who contributed the most. This method of peer evaluation would also prevent students from "gaming" by giving all members the same grade (Sutherland et al., 2013). Due to the unforeseen response, the peer evaluation component was removed from the overall grading criteria. In future courses, other methods of assessing peer evaluation or reaffirming the rationale behind a ranking system could be done to prevent such difficulties from reoccurring.

The other aspect of TBL that teachers did not like was punctuality. The overall sentiment by teachers was that because they were part-time students with work commitments, it was inevitable that they would be late for some TBL classes. In our course, the importance of punctuality was reiterated repeatedly based on the justification that

the integrity and structure of TBL process should be upheld. As the IRAT began at the start of TBL sessions and would only commence for fifteen minutes before the TRAT starts, teachers who come during that time period may disrupt other members who had already started discussing for TRAT. One of the possible solutions for future courses is to rethink the entire implementation of IRAT so that teachers are able to attempt the quiz even if they are late for class. One way can be to introduce an online TBL application where teachers can log on to the application to attempt the IRAT as they are on their way to class.

## CONCLUSION

In conclusion, TBL should be strongly considered as a pedagogical practice in future teacher training programs. Participants in this study achieved more when working in teams and enjoyed the accountability that TBL requires. There were concerns about the peer evaluation process and how it could be modified for the future. In addition, the timing of TBL lessons may need to be adapted when teachers are working professionals due to work commitments and punctuality concerns. However, participants overwhelmingly found the process to be enjoyable and worthwhile. In addition, teachers were very confident that TBL was able to contribute positively to the development of the teaching standards expected by the university.

## REFERENCES

- Chad, P. (2012). The Use of Team-Based Learning as an Approach to Increased Engagement and Learning for Marketing Students: A Case Study. *Journal of Marketing Education*, 34(2), 128-139.
- Chhem, R. K. (2000). Spoon-Feeding in Higher Education. *CDTL Brief*, 3(2).
- Cho, A., Han, S., Yoon, S., Park, J., Yoo, N., & Kim, S. (2010). Methods of Effective Team-Based Learning Administration and Expected Effects on Medical Education. *Korean Journal of Medical Education*, 22(1), 47-55.
- Compton, S., Kamei, R., & Cook, S. (2016). The history and future of Team-Based Learning. *Proceedings of Singapore Healthcare*, 25(1), 3-4.
- Frame, T. R., Cailor, S. M., Gryka, R. J., Chen, A. M., Kiersma, M. E., & Sheppard, L. (2015). Student Perceptions of Team-based Learning vs Traditional Lecture-based Learning. *American Journal of Pharmaceutical Education*, 79(4), 1-11.
- Hrynchak, P. & Batty, H. (2012). The education theory basis of team-based learning. *Medical Teacher*, 34, 796-801.
- Huang, Z., Li, M., Zhou, Y., Ao, Y., Xin, W., Jia, Y., Yang, Y., Cai, Y., Xu, C., Yang, Y., & Lin, H. (2016). Modified Team-Based Learning in an Ophthalmology Clerkship in China. *PLoS ONE* 11(4), 1-10.
- McMahon, K. K. (2010). Team-Based Learning. In B. J. Williams & K. N. Huggett (Eds.), *An Introduction to Medical Teaching* (pp. 55-64). New York, NY: Springer.
- Michaelsen, L. K. & Sweet, M. (2008). The Essentials Elements of Team-Based Learning. *New Directions For Teaching and Learning*, 116, 7-27.
- Moye, P. M., Metzger, N. L., & Matesic, D. (2012). Modified team-based learning (MTBL) and long-term retention in a large classroom setting. *International Journal of Pharmacy Education and Research*, 3(2), 1-6.
- Reinig, B. A., Horowitz, I., Whittenburg, G. E. (2011). The Effect of Team-Based Learning on Student Attitudes and Satisfaction. *Decision Sciences Journal of Innovation Education*, 9(1), 27-47.
- Samad, A. A., Husein, H., Rashid, J. M., & Rahman, S. Z. S. A. (2015). Teaching English Language Pre-service Teachers Using a Team Based Learning Approach. *English Language Teaching*, 8(1), 44-51.
- Singteach (2010). Blending Learning: Where Tradition Meets Technology. *Teacher Ed*, 26. Retrieved from <http://singteach.nie.edu.sg/issue26-teachered-2/>
- Simonson, S. R. (2014). Making students do the thinking: team-based learning in a laboratory course. *Advances in Physiology Education*, 38, 49-55.
- Sutherland, S., Bahramifarid, N., & Jalali, A. (2013). Team-Based Learning From Theory to Practice: Faculty Reactions to the Innovation. *Teaching and Learning in Medicine: An International Journal*, 25(3), 231-236.
- Vasan, N. S., DeFouw, D. O., & Compton, S. (2011). Team-based learning in anatomy: An efficient, effective, and economical strategy. *Anatomical Sciences Education*, 4(6), 333-339.
- Yang, C. (2015). Tech in, school's out by year 2065? The Straits Times, retrieved from <http://www.straitstimes.com/singapore/education/tech-in-schools-out-by-year-2065>
- Zgheib, N. K., Dimassi, Z., Akl, I. B., Badr, K. F., & Sabra, R. (2016). The long-term impact of team-based learning on medical students' teamperformance scores and on their peer evaluation scores. *Medical Teacher*, 38(10), 1017-1024.