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

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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
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 immediate confirmation of learning, enhances engagement, 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 et al. (2010) is that team assignments in the application phase should promote both student learning and team development. 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, Reining et al. (2011) examined 137 students’ attitudes and satisfaction towards a TBL course in upper division accounting. The authors found that students generally responded 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 Australian 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 traditional pedagogy in Singapore. The researchers found that student performance was not only higher in the TBL-based course but also perceived TBL to be a motivator for team learning. Additionally, these students developed professional, and personal learning and team development. Assignments and AE should be designed to promote both student learning and team development. 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, there is a higher percentage of passive learning (as cited in Singtine, 2010, p. 7).” Chimen (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 (Chimen, 2000). While such spoon-feeding used to be common in Singapore, schools have began 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 et al., 2011). 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, C & 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 (RSE 850 Technology for Teaching). The course aimed to train teachers on how to use mobile technology for teaching all students regardless of content area, grade level, age, or ability. A course designed to foster learning. Using technology to develop practical solutions for teachers’ personal and professional implementation. Laptops are being used to consider all students needs and discuss on the front of the class was used to mark the start and end of each IRAT. No additional time was given for later-comers.

**Grading Process**

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 teacher should know about mobile tools and be able to use in class. The teacher’s individual blog, which accounted for 20% of the overall grade, required them to describe their personal plan to implement technology into their learning environment. 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.

**Data Collection**

Both quantitative and qualitative data were collected to establish the effectiveness of TBL implementation in our course. Quantitative data was collected through the TBL questionnaire which was comprised of a demographics section and closed-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 that 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 to be 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.

RESULTS
Quantitative Analysis

Pearson correlations were performed with an alpha of 0.05 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 (r = 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.

A paired samples t-test with an alpha of .05 was used to compare the means of IRAT and TRAT scores. The results indicated there was a strong positive correlation coefficient was calculated. There was a strong positive correlation between IRAT and FCG, r(28) = .495, p < .01. Figure 3 shows a bar chart comparing the mean scores between IRAT and FCG.

The correlation analysis of the four TBL components showed an average correlation of 0.35 (see Table 3). 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 experience”, “Understood”, “Helpful”, “Beneficial learning experience”.

The Pearson correlation coefficient for the TBL performance scores indicated a positive correlation between IRAT and TRAT. The mean correlation between IRAT and TRAT was 0.49, r(28) = .495, p < .01. The mean correlation between IRAT and FCG was 0.35. The correlations between IRAT, TRAT, AE, and FCG are shown in Table 2. The high correlation between IRAT and TRAT indicated that teachers had applied their learning effectively in team readiness discussions. The correlation between IRAT and FCG indicated that teachers had applied their learning effectively in the form of application exercises.

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 (Mithasem & 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., 2021). The use of TBL was found to be significant in increasing students’ performance, as well as their ability to meet its learning objectives.

The use of TBL in the Asian teaching context provided a unique opportunity to explore its effectiveness in improving students’ performance. The study found that TBL enhanced students’ learning experience in class, as well as their ability to meet its learning objectives. The findings of this study are consistent with previous research on the effectiveness of TBL in improving students’ performance (Vasan et al., 2021).

The table below shows a summary of the findings of this study:

<table>
<thead>
<tr>
<th>Statement</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBL was a suitable instructional design for the course.</td>
<td>1 (3.2%)</td>
<td>2 (6.5%)</td>
<td>11 (35.5%)</td>
<td>13 (41.9%)</td>
<td>4.10 ± 1.01</td>
<td></td>
</tr>
<tr>
<td>The use of TBL enhanced my learning experience in class.</td>
<td>1 (3.2%)</td>
<td>2 (6.5%)</td>
<td>11 (35.5%)</td>
<td>16 (51.6%)</td>
<td>4.29 ± .97</td>
<td></td>
</tr>
<tr>
<td>The use of TBL was able to meet its learning objectives.</td>
<td>3 (6.5%)</td>
<td>0 (0.0%)</td>
<td>3 (9.7%)</td>
<td>4 (12.9%)</td>
<td>4.25 ± 1.06</td>
<td></td>
</tr>
<tr>
<td>The use of TBL improved my interpersonal and group interaction skills.</td>
<td>1 (3.2%)</td>
<td>2 (6.5%)</td>
<td>6 (19.6%)</td>
<td>12 (38.7%)</td>
<td>3.90 ± 1.04</td>
<td></td>
</tr>
<tr>
<td>The use of TBL increased the extent of my usual classroom participation.</td>
<td>2 (6.5%)</td>
<td>2 (6.5%)</td>
<td>6 (19.6%)</td>
<td>14 (45.2%)</td>
<td>28 (85.8%)</td>
<td>3.77 ± 1.12</td>
</tr>
<tr>
<td>The TBL activities encouraged me to think critically.</td>
<td>1 (3.2%)</td>
<td>2 (6.5%)</td>
<td>6 (19.6%)</td>
<td>14 (45.2%)</td>
<td>16 (51.6%)</td>
<td>4.35 ± .88</td>
</tr>
<tr>
<td>Learning through small groups was a way to improve my understanding of the course content.</td>
<td>1 (3.2%)</td>
<td>2 (6.5%)</td>
<td>6 (19.6%)</td>
<td>14 (45.2%)</td>
<td>4 (12.9%)</td>
<td>4.16 ± 1.04</td>
</tr>
<tr>
<td>Overall, I prefer TBL to traditional lectures.</td>
<td>1 (3.2%)</td>
<td>2 (6.5%)</td>
<td>6 (19.6%)</td>
<td>14 (45.2%)</td>
<td>11 (35.5%)</td>
<td>4.06 ± 1.10</td>
</tr>
<tr>
<td>I would recommend the use of TBL in future courses.</td>
<td>1 (3.2%)</td>
<td>2 (6.5%)</td>
<td>6 (19.6%)</td>
<td>14 (45.2%)</td>
<td>13 (41.9%)</td>
<td>4.13 ± .97</td>
</tr>
<tr>
<td>Overall, I am satisfied with the use of TBL in future courses.</td>
<td>1 (3.2%)</td>
<td>2 (6.5%)</td>
<td>6 (19.6%)</td>
<td>14 (45.2%)</td>
<td>13 (41.9%)</td>
<td>4.23 ± .96</td>
</tr>
</tbody>
</table>

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

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 positive correlation could be attributed to the fact that teachers who performed well in IRAT also tended to perform well in TRAT. This suggests that teachers who are able to apply their learning effectively in team readiness discussions are also likely to perform well in application exercises.

In conclusion, the findings of this study suggest that TBL is an effective instructional design for improving students’ performance in an Asian teaching context. The use of TBL in traditional lectures can be enhanced by incorporating team readiness discussions and application exercises. The study also highlights the importance of teacher training in the effective implementation of TBL in the classroom.
Table 4. The themes, definitions, percentage of teachers who responded, and most representative statements for each theme.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Definition</th>
<th>Percentage of Teachers who found theme to be most interesting</th>
<th>Most representative statements for each theme.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most helpful</td>
<td>The aspect(s) of the course that teachers found to be the most helpful</td>
<td>83%</td>
<td>The themes, definitions, percentage of teachers who responded, and most representative statements for each theme.</td>
</tr>
<tr>
<td>Peer evaluation through ranking</td>
<td>A remark that pertains to the hallmark of the peer evaluation system</td>
<td>83%</td>
<td>The themes, definitions, percentage of teachers who responded, and most representative statements for each theme.</td>
</tr>
<tr>
<td>Punctuality</td>
<td>A remark that pertains to the diligence of the need to be sharply on time for classes</td>
<td>83%</td>
<td>The themes, definitions, percentage of teachers who responded, and most representative statements for each theme.</td>
</tr>
</tbody>
</table>

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 teachers 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 peer evaluation pertaining to their 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.

CONCLUSION

In conclusion, TBL should be strongly considered as a pedagogical practice in future teacher training programs. 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


