Occupational Therapy Students' Experiences of Team-Based Learning: A Multi-year Study

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Abstract

Many health sciences disciplines have adopted team-based learning (TBL) as part of their education pedagogy, with studies showing increased classroom participation and learner satisfaction. However, it will be beneficial to explore the learning experiences of occupational therapy students in TBL using a mixed methods approach. In an undergraduate occupational therapy program, students undertook three clinical modules using TBL in years two and three. This study explored their perceptions and experiences of TBL. This was a mixed methods prospective cohort study, during which two cohorts of students from Academic Year (AY) 2016 and AY2017 completed the Team-Based Learning Student Assessment Instrument (TBL-SAI) at the end of their first (midway evaluation) and third clinical module (final evaluation). In addition, they completed a semi-structured survey to share their learning experience. One-hundred twenty-seven occupational therapy students from both cohorts had full data and their results showed higher than neutral for Accountability, Preference for TBL, and Student Satisfaction sub-scales and composite scores at midway and final survey. Collectively, there were no significant changes in TBL perceptions, and no significant relationships were found between TBL-SAI scores and module results. Within the AY2017 cohort, there was positive moderate association between Accountability sub-scale midway score and module results. Qualitative analysis produced four themes: 1) power of discussion; 2) time use; 3) changed learning process and outcome; and 4) tailoring aspects of TBL to enhance learning. Occupational therapy students' scores in the TBL-SAI domains were higher than neutral at midway and final evaluation. TBL may be a suitable method to aid learning of clinical occupational therapy knowledge.

Keywords

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Occupational Therapy Students' Experiences of Team-Based Learning: A Multi-year Study

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ABSTRACT

Many health sciences disciplines have adopted team-based learning (TBL) as part of their education pedagogy, with studies showing increased classroom participation and learner satisfaction. However, it will be beneficial to explore the learning experiences of occupational therapy students in TBL using a mixed methods approach. In an undergraduate occupational therapy program, students undertook three clinical modules using TBL in years two and three. This study explored their perceptions and experiences of TBL. This was a mixed methods prospective cohort study, during which two cohorts of students from Academic Year (AY) 2016 and AY2017 completed the Team-Based Learning Student Assessment Instrument (TBL-SAI) at the end of their first (midway evaluation) and third clinical module (final evaluation). In addition, they completed a semi-structured survey to share their learning experience. One-hundred twenty-seven occupational therapy students from both cohorts had full data and their results showed higher than neutral for Accountability, Preference for TBL, and Student Satisfaction sub-scales and composite scores at midway and final survey. Collectively, there were no significant changes in TBL perceptions, and no significant relationships were found between TBL-SAI scores and module results. Within the AY2017 cohort, there was positive moderate association between Accountability sub-scale midway score and module results. Qualitative analysis produced four themes: 1) power of discussion; 2) time use; 3) changed learning process and outcome; and 4) tailoring aspects of TBL to enhance learning. Occupational therapy students' scores in the TBL-SAI domains were higher than neutral at midway and final evaluation. TBL may be a suitable method to aid learning of clinical occupational therapy knowledge.

Introduction

Many medical and health sciences disciplines have adopted team-based learning (TBL) as part of their education pedagogy over the past decade, with studies showing increased classroom participation and learner satisfaction (Koles et al., 2010; Sisk, 2011). TBL is a form of flipped classroom method based on four underlying principles: (1) permanent teams are formed with equal distribution of skills and competencies; (2) student accountability is fostered through pre-class reading and team work; (3) team assignments are given to promote learning and development; and (4) immediate feedback is given (Fatmi et al., 2013; Michaelsen & Richards, 2005). The structure of TBL follows a three-step cycle (Lexén et al., 2018; Parmelee & Michaelsen, 2010):

1. faculty provides mandatory reading for students to prepare prior to class;
2. readiness assurance tests to ascertain students' acquired knowledge in an individual and team format;
3. team-based application class, during which students apply tested knowledge to decide on the best solution(s) to a problem scenario.

In occupational therapy education, TBL is seen as a relatively new teaching and learning method. A qualitative study using grounded theory explored students' experience of a mental health module delivered through a hybrid approach of TBL and problem-based learning (PBL; Lexén et al., 2018). Results showed that the students perceived a safe discussion setting where instructors were engaging and the module was clear in structure. The students also perceived increased professional competence and were more confident in encounters with persons who behaved differently (Lexén et al., 2018). However, the results were specific to the hybrid approach, and could not be generalized to the impact of TBL. Another study with occupational therapy master's degree level students found that when compared with TBL, students had significantly higher positive perception of lecture-based instruction, when students were surveyed using an adapted questionnaire (Zachry et al., 2017). One possibility cited by the authors was that the students had been exposed to lectures from elementary to high school and were more familiar with this learning approach. Moreover, the module selected for lecture-based instruction was gross anatomy, which had a large amount of factual content and rendered itself appropriate for this form of instruction (Zachry et al., 2017). Lastly, a study with two cohorts of master's degree students used the Team-Based Learning Student Assessment Instrument (TBL-SAI) to measure changes in their perception of TBL across one year (Carson & Mennenga, 2019). Quantitative analysis of first- and third-term students showed significant changes in accountability, satisfaction with TBL and preference for TBL over traditional lecture (Carson & Mennenga, 2019). Overall, these studies complemented findings in health sciences literature on students' preference for TBL but findings on improved knowledge and academic performance were mixed (Fatmi et al., 2013; Nation et al., 2016; Sisk, 2011; Teixeira et al., 2019).

At the Singapore Institute of Technology's BSc (Hons) Occupational Therapy program, students undertake two clinical modules ('Daily Living Skills' and 'Work and Productivity') in year two and one clinical module ('Play, School, and Transition') in year three using TBL. 'Daily Living Skills' and 'Work and Productivity' cover occupational

therapy assessments and interventions for a range of neurological, orthopedics and psychiatric/neurodevelopmental conditions, while 'Play, School, and Transition' covers occupational therapy for children and adolescents. The TBL classes consist of Readiness Assurance Tests (RATs) and team-based case applications.

Individual Readiness Assurance Test and Team Readiness Assurance Test
Each teaching trimester consists of 15 weeks, with a recess week at week seven. Before the start of the year two academic trimester, the instructor of 'Daily Living Skills' puts students into permanent teams, based on equal distribution of gender, ethnicity and year one cumulative grade point average (cGPA) results. Students with prior working experience are also equally distributed. Students keep to the same teams throughout the three TBL modules.

Before each TBL class, the faculty uploads reading materials and recorded lectures in the students' online learning management system. Students are expected to view the materials, in preparation for the in-class Individual Readiness Assurance Test (iRAT) and Team Readiness Assurance Test (tRAT). At the start of the actual class, students attempt the iRAT, which are multiple-choice questions (MCQs) administered individually on an online assessment system. After that, the students proceed to attempt the tRAT, which are the same MCQs but the students can now discuss with their teammates to arrive at a consensus. Both iRAT and tRAT are done in a closed book manner. Upon completion of iRAT and tRAT, the teams review their questions and answers and post questions on an online platform for the faculty to answer during class. By looking at the iRAT/tRAT scores and the questions posed by students, faculty often have a good idea on students' knowledge gaps. To clarify doubts, faculty can then conduct a Just-in-Time lecture to address areas that are not clear. These lectures are often a short review of pre-class materials or additional information to consolidate learning. All faculty involved in TBL classes undergo training by the university's teaching and learning center.
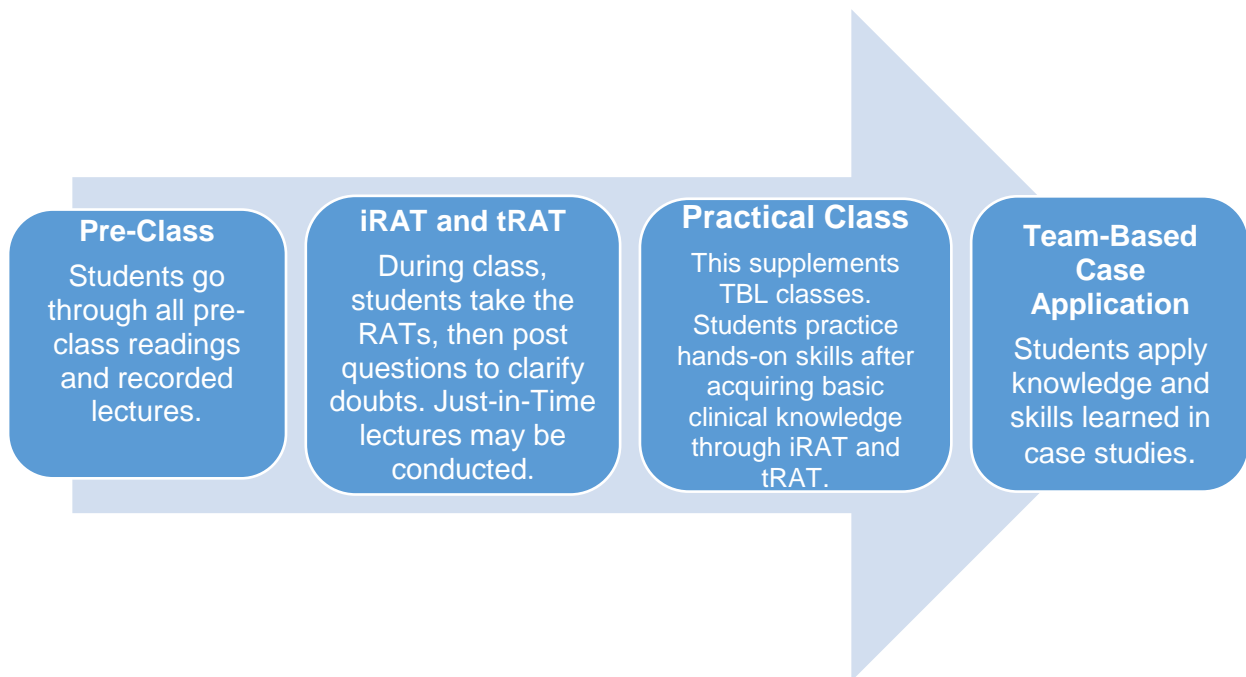
Team-Based Case Application
After establishing factual clinical knowledge in iRAT/tRAT, practical classes are scheduled to equip students with hands-on skills. These classes may involve manual handling, fabrication of orthosis, role playing on clinical encounters, among other tasks. The week then ends with a Team-Based Case Application class. During this class, students apply knowledge learned in iRAT/tRAT sessions to case studies. Case studies are clinical scenarios developed by faculty to challenge students' clinical reasoning across the spectrum of care. For each question, the teams select possible options and all teams report their answers simultaneously. Faculty then ask them to present the rationale for their selected options. Hence, this generates discussions on the thought process behind clinical reasoning and encourages students to think deeper. Figure 1 shows the sequence of the TBL classes on a typical week.

Assessments for the module consist of iRAT/tRAT, a practical exam, a final written exam, and peer evaluation. During peer evaluation, students rate their teammates' contributions to tRAT and team-based case applications (Fete et al., 2017). All these assessments contribute to the module results.

Building on previous research, this study attempted to elucidate students' experiences in TBL as they progressed through three TBL clinical modules. It aimed to capture changes in student perceptions of TBL and explore relationships between their experiences and academic performance (as measured by module results).

Figure 1
Sequence of Team-Based Learning Classes Each Week (Applicable to 'Daily Living Skills', 'Work and Productivity' and 'Play School and Transition' Modules)

Pre-Class
Students go through all pre-class readings and recorded lectures.

iRAT and tRAT
During class, students take the RATs, then post questions to clarify doubts. Just-in-Time lectures may be conducted.

Practical Class
This supplements TBL classes. Students practice hands-on skills after acquiring basic clinical knowledge through iRAT and tRAT.

Team-Based Case Application
Students apply knowledge and skills learned in case studies.

Note. iRAT= Individual Readiness Assurance Test; tRAT= Team Readiness Assurance Test; RAT= Readiness Assurance Test

Methodology

This was a mixed methods prospective cohort study, during which an online survey was administered at the end of the first clinical module 'Daily Living Skills' (midway evaluation) and at the end of the third clinical module 'Play, School and Transition' (final evaluation). A mixed methods approach was chosen for complementarity purposes, so that the results from the quantitative and qualitative components could bring about elaboration, illustration, enhancement and clarification (Bryman, 2006). Ethics approval for this study was granted by the Singapore Institute of Technology Institutional Review Board (study number: 20170052). The objectives of this study were:

1. to explore students' perceptions and experiences of TBL;
2. to capture changes in student perceptions of TBL, as they progressed through the three TBL clinical modules;
3. to explore relationships between students' perceptions of TBL and their academic performance (as measured by module results).

Participants and Procedure

Two cohorts of students from Academic Years (AYs) 2016 and 2017 participated in this study through convenience sampling. There were 58 students from the AY2016 cohort and 79 students from the AY2017 cohort. For the AY2016 cohort, the team size was around five. For the AY2017 cohort, the team size was around seven. The first TBL clinical module, 'Daily Living Skills' was offered on year two trimester one (September to December). During the first class, students were briefed about this research study and given one week to decide on consent to participate. At the end of the module, they were given a secure online survey link, which contained questions from the TBL-SAI, as well as open-ended questions to obtain information on students' demographic profile and subjective learning experience (midway evaluation). Students proceeded to undertake the second TBL clinical module, 'Work and Productivity' in year two, trimester two (January to April the following year). Finally, in year three, trimester one, the students undertook the third TBL clinical module, 'Play, School and Transition' (September to December). During its last class, they were again given a secure online survey link with the TBL-SAI and open-ended questions (final evaluation). The online survey took about 30 minutes to complete. Consent forms and data were collated by an administrator not involved in other aspects of this study. For both cohorts, approximately 12 months lapsed between collection of midway and final data.

Instruments

The TBL-SAI is an established valid and reliable measurement of students' perceptions of TBL and has been used in previous studies on TBL experiences (Carson & Mennenga, 2019; Mennenga, 2012; Teixeira et al., 2019). It is a 33-item instrument and consists of three subscales, namely 'Accountability,' 'Preference for Lecture or Team-based Learning,' and 'Student Satisfaction.' 'Accountability' describes the extent that students prepare in advance for a class and/or contribute in team discussions (Mennenga, 2012), with a higher score indicating higher level of accountability. In addition, a subscale score of above 24 indicates higher than neutral accountability (Mennenga, 2010). Similarly, a score higher than 48 on the 'Preference for Lecture or Team-based Learning' subscale indicates a preference for TBL, while a score higher than 27 on the 'Student Satisfaction' subscale indicates higher level of satisfaction with TBL (Mennenga, 2010). A composite score can be obtained by summing up all the subscale scores, with 99 or more denoting overall favorable experience with TBL.

Factor analysis was conducted to establish the three subscales, with overall internal consistency of Cronbach α =0.941 (Mennenga, 2012). The Accountability, Preference, and Satisfaction subscales also had high Cronbach α of 0.782, 0.893, and 0.942, respectively (Mennenga, 2012).

For the qualitative component, the phenomenology approach was used. Open-ended questions were gathered from literature (Lexén et al., 2018) to explore experiences and perception of TBL, in order to understand broadly how learning took place during these classes. The following questions were used in the survey:
1. Which aspects of TBL are the most helpful for your learning?
2. Which aspects of TBL are the least helpful for your learning?

3. Suggest other modes of delivery that may be more suitable for this module (e.g. lecture/tutorial) and explain your reasons. If there is no other more suitable mode of delivery, please indicate why.
4. Describe your experience of peer evaluation.
5. Please add any other comments you may have about your experience with TBL.

Data Analyses
Quantitative data analysis was carried out by IBM SPSS Statistics Version 25 (IBM-Corp, 2017) while NVivo Version 12 (QSR International Pte Ltd, 2018) was used to analyze the qualitative data. For the quantitative data, paired t-test was conducted to capture changes in TBL-SAI scores between the two time points, as normal distribution of data was observed. Spearman's rho was used to explore associations between TBL-SAI scores with the module results. Statistical significance was set at $p < 0.05$.

The qualitative data was exported by an independent administrative staff and entered into NVivo 12 Pro (QSR International Pte Ltd., 2018) by the second author. Thematic analysis was used to analyze the qualitative data. The second and third authors read through the responses independently and discussed as a pair to immerse in the data. Next, the data was labelled and coded by the second author. A codebook was created to describe each code, and the second and third author looked through the codes to find convergence and divergence, and this process was iterative over several discussions (Patton, 2015).

Results

Students' TBL-SAI Scores
There were 127 occupational therapy students from both cohorts who had full midway and final evaluation data for analysis. Table 1 shows their demographic profile and Table 2 shows their TBL-SAI mean scores. At baseline, the students had higher than neutral Accountability sub-scale scores (mean= 31.90, SD=3.37), higher than neutral Preference for Team based Learning sub-scale scores (mean=50.94, SD=6.26) and higher than neutral Student Satisfaction sub-scale scores (mean=32.84, SD=5.08). Their final sub-scales and composite scores were also higher than neutral.

Collectively, there were no statistically significant changes in TBL-SAI scores between midway and final evaluation. However for the AY2016 cohort, paired t-test showed significant reduction in TBL-SAI composite score (t(55)=3.02, p < 0.001) at the end of the third module. This cohort's final composite score was still higher than neutral (mean= 110.68, SD=15.90).

In terms of relationships between students' perceptions of TBL and academic performance, there were also no statistically significant associations between TBL-SAI scores and module results for the 127 students. However, among the AY2017 cohort (n=71) at midway evaluation, Spearman's rho showed a positive moderate association between their Accountability sub-scale scores and their module results (r = 0.32, p<0.001).

Table 1

Description of Study Sample

		Cohort	N	Mean	SD
Age		AY16	56	21.29	1.79
		AY17	71	22.20	3.05
Number of Years Worked Prior to Starting OT Program		AY16	56	0.55	0.89
		AY17	71	1.08	1.99
		Cohort	N	Total Number (127)	Percentage
Prior Education	'A' Levels	AY16	30	57	44.9%
		AY17	27		
	Degree	AY16	0	4	3.1%
		AY17	4		
	Diploma	AY16	26	65	51.2%
		AY17	39		
	IB	AY16	0	1	0.8%
		AY17	1		

Note: SD= standard deviation

Table 2

Team Based Learning Student Assessment Instrument (TBL-SAI) Scores

	Midway		Final		Neutral Cut-off
	Mean	**SD**	**Mean**	**SD**	
Accountability Sub-scale	31.96	3.21	31.42	3.73	24
Preference for Team Based Learning Sub-scale	50.95	6.28	49.86	6.65	48
Student Satisfaction Sub-scale	32.82	5.10	31.82	5.27	27
Composite Score	115.73	12.37	113.09	12.84	99

Note: SD= standard deviation

Students' Experiences of Team-Based Learning-Qualitative Results
Analysis of the qualitative data generated four themes, capturing the students' perceptions and experiences of TBL, thus addressing the first research objective. The four themes were: 1) the power of discussion; 2) time use; 3) changed learning process and outcome; and 4) tailoring aspects of TBL to enhance learning.

The Power of Discussion
The majority of the students (n=118) reported that the nature of discussion in the TBL context was important. Most students stated that the exchange of different viewpoints aided their understanding of the topic. "*When we get to brainstorm and listen to different perspectives from our team members. It helps to broaden my horizons whenever I approach certain issues and learning how certain issues can be viewed from a different perspective*" (Student 105). Students shared that the nature of discussion provided them opportunities to clarify their doubts and this process of clarification and learning was iterative. Student 113 shared that, "*I get to clarify my doubts as soon as I have them, since I can just ask my friends about it, compared to having to compile a list of questions and then asking the prof about it at the end of the lecture.*" Learning through discussion also provided them opportunities to develop their analytical and communication skills.

Students also noted the importance of team dynamics in TBL group discussions. Some students appreciated working with diverse team members. "*I like that everyone is mixed together so it is a chance to work with new people*" (Student 65). Others shared difficulties with working with teammates who were less engaged, "*Some members could*

be uninterested in the learning activities and would rather do their own things. As an auditory learner, it is very difficult for me to pay attention or even have productive discussions with them" (Student 128). Other challenges included the struggle to reconcile different opinions, as well as feelings of uncertainty regarding learning the correct information and concepts through discussions.

Time Use

The use of time was mentioned by 54 students. Some students (n=18) stated that the overall time taken for a TBL class was too long. "*3-4 hours of working in a team was quite draining for me, and I feel that 1-2 hours of it is sufficient for my learning. Past the 2-hour mark, I feel myself not being able to pay attention and getting easily distracted*" (Student 45). In addition, students mentioned that discussions sometimes lacked focus and peers would be "*talking about irrelevant topics during discussion*" (Student 118). On the other hand, a small number of students (n=5) said they preferred longer sessions. Hence, the pace of lesson progression was perceived as too fast for some and too slow for others. Some students also specifically said they wanted more time for questions and answers with the faculty.

Changed Learning Process and Outcome

TBL changed the way in which students learned and engaged in class and this theme was reflected by 37 students. Student 33 mentioned that "*I think this is pretty good as it forces us to gain some knowledge before coming and also using Stormboard to get questions from the students is good as more people will be willing to ask questions.*" Students voiced several positive outcomes such as better awareness of blind spots, deeper understanding of learning content, and increased ability to consolidate learning. This was illustrated by Student 1736, who reflected that "*the discussion process also helps me to better remember and consolidate the pre-reading material.*" Learning was also perceived as more fun, as quoted by Student 1712, "*it is helpful when everyone listed out their doubts about certain issue/topic, after that we will all discuss together. From this, we learn together as a team and when peers explain to you the concept in their own terms, it makes learning fun and easier to understand.*"

Tailoring Aspects of TBL to Enhance Learning

More than half of the students (n=91) suggested tailoring certain aspects of TBL to improve the process and their experience of TBL. Some students preferred traditional lectures and others would have liked more tutorials and practical sessions, as they "*learn better through demonstration and practice of hands on*" (Student 30). Others suggested more problem-based learning, role play, videos, and to revert to non-flipped classroom. Students also stated they would like more faculty support and opportunities for faculty to confirm that the information they had learned was correct. Some students (n=25) reported they preferred group sizes to be smaller. "*The team might be too large and span over quite a few tables which make discussion very difficult - half of the group could be discussing on one part and the other half on another part, resulting in confusion when we discuss as we are all talking about different things*" (Student 129).

Other suggestions included incorporating discussion during the question and answer segment and rotating teammates. Some students (n=23) reported that TBL was beneficial and did not see the need for changes. "*The current modes applied are sufficient for us students to learn the necessary content we need. There is a nice balance between lecture style and class engagement as our lecturers also provide insights during lecture which is important for us to take note of as future therapists and during class discussions, we can expand our thinking caps from there*" (Student 114).

Discussion

This study found that occupational therapy students' midway and final TBL-SAI sub-scales and composite scores were higher than the neutral cut-off, suggesting that these students generally had positive accountability, satisfaction, and preference for clinical modules to be conducted using TBL (Carson & Mennenga, 2019; Mennenga, 2012). However, there was no association between TBL-SAI scores and module results, except for positive moderate correlation between AY2017 cohort's Accountability midway sub-scale scores and their module results. Studies on improvement in module results through TBL have been mixed (Fatmi et al., 2013; Sisk, 2011). Similar to our current study, many of these studies using knowledge scores as outcomes adopted single-group, pretest-posttest designs. Therefore, it was difficult to determine whether there was any component of TBL which could enhance academic performance. In the thematic analysis, students shared that when teammates were accountable and came prepared for productive discussions, they were able to clarify doubts and learn better. On the other hand, teammates who were ill-prepared might digress to irrelevant topics and impeded learning. Hence, when students were accountable to their learning, TBL appeared to impact upon their learning process and outcome, as reflected in the third theme. However, there could be other unknown factors which might have impacted on students' module results, hence the lack of significant relationship between TBL-SAI scores and module results for the whole sample.

There were also no significant changes in overall students' perception of TBL. However, the AY2016 cohort had significant reduction in TBL-SAI composite score, even though the final composite score was still higher than neutral. The thematic analysis was unable to ascertain evident changes in this cohort's TBL experiences. However, the AY2016 cohort was the first cohort to experience TBL. Therefore, faculty involved in the three clinical modules were new to this instructional mode. This might have resulted in variations in TBL facilitation and time management skills, which could have affected students' experiences. There is currently a lack of studies investigating how faculty's competency and confidence in delivering TBL influence students' experience. However, it is known that TBL demands student-centered classroom management skills and time is needed for faculty to build up confidence in this instructional method (Rajalingam et al., 2018; Salam et al., 2016).

This was the first mixed methods study on the use of TBL in occupational therapy education and had its methodological limitations. In order to have equitable learning outcomes across the cohort, it was not possible to carry out an experimental study by randomizing students between TBL and traditional lecture within the module. However,

students undertook a module in year 3 that was conducted using problem-based learning method. It would be useful to compare students' experiences between these two learning methods. More robust study designs to investigate TBL's effectiveness in achieving desired module results and other learning outcomes would also be worthwhile. Qualitative data collected via online survey provided rich information on the experiences of occupational therapy students. However, the open-ended questions were developed based on literature and were not content validated by expert panel. Adding focus groups might have yielded more insights and provided triangulation to the answers from open-ended questions. Lastly, it will be useful for future studies to inquire into faculty's experiences and confidence in delivering TBL.

Implications for Occupational Therapy Education
This mixed methods study involving more than 100 students provided some insights into enhancing the delivery of TBL for occupational therapy clinical modules. The first theme of the qualitative analysis expounded the power of discussions when students came to class prepared. Focused discussions deepened learning and the whole team benefitted from the process of deriving at the most appropriate answer. Therefore, efforts need to be taken for students to understand the benefits of being accountable to their teammates during TBL sessions. Having smaller team size of about five may also facilitate engagement and accountability. As seen from the thematic analysis, students tended to rely on faculty for content knowledge and were asking for more faculty confirmation to verify content accuracy. In occupational therapy practice however, clinical reasoning often involves weighing and prioritizing different factors within a practice framework, which involves the iterative process of planning, implementing and reflecting. Being less reliant on faculty and more accountable to oneself and the team will thus facilitate the learning process of occupational therapy reasoning.

Thompson and colleagues (2007) investigated factors that led to successful implementation of TBL and found that faculty buy-in, expertise, resources and time were the top five factors. It was not ascertained if the AY2016 cohort's experience of TBL was affected by faculty factors. From the thematic analysis, some students found the discussions too long, whereas others found them too short. A few students also asked to revert to traditional lecture style. Hence, it takes skills and patience for faculty to meet the differing learning needs of students, which may include being skilled in time management and reinforcing pertinent information after students have finished their discussions. Faculty will also need to spend time and effort to counsel students who are less prepared for TBL classes and to encourage competent students to help weaker students along.

In summary, faculty who wish to use TBL should fully harness the power of discussion to deepen student's critical thinking. Faculty can balance encouraging student accountability with reinforcing pertinent concepts through clarification sessions.

Conclusion

Occupational therapy students' perceptions of TBL in the areas of accountability, satisfaction, and preference for TBL appeared to be positive. Collectively, there were no significant changes in TBL perceptions, and no significant relationships were found between TBL-SAI scores and module results. However, within the AY2016 cohort, there was a significant reduction in TBL-SAI composite score, even though the final composite score was still higher than neutral. Within the AY2017 cohort, the midway accountability sub-scale score was found to have a moderate positive association with module results. Students valued the opportunity to 'think deeper' and learn from peers. They also found that TBL changed their learning process and made lessons more fun. In summary, TBL may be a suitable method to aid students' learning of clinical occupational therapy knowledge.

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