Optometry Students' Attitudes about Team-Based Learning

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Abstract

Background: *Team-based learning (TBL) is a method for fostering critical thinking skills in high functioning teams. This study examined optometry student attitudes about TBL.* ***Methods:*** *Students (N=91) completed a 15-item, five-point, Likert-scale survey regarding their attitudes about two consecutive four-month TBL courses. Four peer evaluation items were added to the second survey. Mann Whitney U tests (p=0.05) compared course differences.* ***Results:*** *Term response rates were 95% and 98%. First-term student satisfaction across four categories was: team experience (4.29), quality of learning (3.75), clinical reasoning ability (3.96) and professional development (3.78). There were significant second-term satisfaction increases with 8 of the 15 statements and no significant decreases. Peer evaluation satisfaction was 3.58.* ***Discussion:*** *Optometry student satisfaction with TBL was favorable and improved with additional experience.*

Key Words: *team-based learning, student satisfaction, optometric education, teaching methods, evaluation*

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Background

Two important competencies in any healthcare practice are the ability to think critically and work effectively in a team.[1] Students need to learn and apply critical thinking skills before offering viewpoints and evaluating statements made by others. Ideally, these competencies should be taught using appropriate methods that are based in educational theory.

Traditional education in the healthcare professions is teacher-centered and content-driven.[2] The goal is to transfer information from teachers to students, who then memorize facts. Recalling facts is important but it does not ensure that students have gained a true understanding of the material and developed an ability to apply the information in novel contexts.[3] Alternatively, dialectic teaching is the practice of logical discussion used when determining the truth of a theory or opinion.[3] Team-based learning (TBL) is a form of dialectic teaching that was developed by Larry Michaelsen in the 1990s and grounded in constructivist educational theory.[4] It is an example of a flipped classroom approach where the content is learned by independent study and the application occurs in the classroom.[5]

TBL is increasingly used in North America, Europe, Asia and Australia in medical and other healthcare education, targeting multiple levels of learners and a variety of content areas.[6] TBL has been shown to have a positive impact on learning in a recent systematic review of the literature.[7] TBL in optometric education is relatively new. While its inclusion has been reported,[8] no studies of its implementation have been published. This paper briefly reviews TBL concepts and evaluates a Canadian Doctor of Optometry program's student attitudes about teamwork experienced within a TBL framework.

TBL Key Concepts

The educational theory that informs TBL is published elsewhere;[4] however, key points are summarized herein. TBL is an active learning method that is "learner-centered and instructor-led."[9] It is used for large classes that are divided into smaller groups of 5-7 students

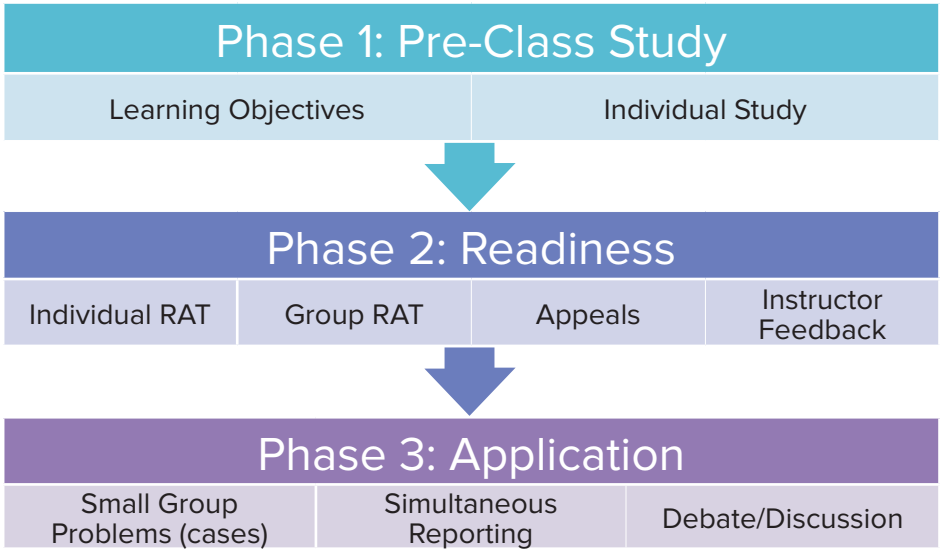
(referred to as teams). Ideally, diversity is maximized within teams and minimized between teams. In that way, each team has access to the range of knowledge and experience of the members that can be drawn upon when collaboratively solving problems.[4]

TBL consists of modules with three repeating phases **(Figure 1)**. The first phase involves a prior learning assignment where the instructor assigns students study material in advance of the learning session based upon pre-determined learning objectives.[3]

The second phase has four steps that focus on readiness assurance. The students first take an individual readiness assurance test (IRAT), which is a multiple-choice test that assesses concepts from the prior learning assignment. This test assesses recall of factual material. Second, the team takes the same test as a group; this step is called the group readiness assurance test (GRAT). Using an Immediate Feedback Assessment Technique (IF-AT) scratch card, which contains the correct answer for each question, the group members work together on the answers until all correct answers are known. Typically, teams perform better than the highest score of any individual member.[10,11,12] Third, the teams are allowed to challenge, in writing, any questions that they do not feel are fair or appropriate. Each challenge is carefully considered by the instructor, who may then discount the question. In the final step, any outstanding misconceptions around the content as measured by a high error rate on the test are addressed by the instructor in a mini-lecture format to the entire group.[3]

In the third and final phase of the process, the teams solve problems that are based on the material that has been learned. These problems are called application exercises and are designed to follow what Michaelsen et al.[3] calls the '4 S' principle: the problems are the same for all of the groups; the problems are significant for the learners; the groups must make a specific choice for the correct answer (e.g., a multiple-choice question); and the results are simultaneously reported by all groups.[3] Ideally, the problems have multiple solutions that allow for debate of the correct answer among teams who defend their answer to other teams. The instructor facilitates the discussion among teams without lecturing.[3]

Figure 1
The Three Phases of the Team-Based Learning Process (Reproduced from Hrynchak P, Batty H. The educational theory basis of team-based learning. Med Teach 2012;34:796-801.)



RAT = Readiness Assurance Test

Once or twice during the course, team members give feedback to other members of their group regarding team performance. This peer evaluation allows the students to practice giving and receiving feedback to members about their ability to work in a productive team.[3]

TBL facilitates the development of certain skills that may not be addressed by other established active learning strategies such as problem-based learning (PBL). While TBL and PBL are both case-based small-group teaching methods, the methods diverge in significant ways. For example, in PBL, there is one tutor per group and the case is the starting point of the learning session. The students set their own learning goals and engage in independent study that they bring back to the group to share under the guidance of the tutor.[13] The structure of TBL requires fewer tutors, reduces tutor variability and creates unique opportunities for learners to develop their critical thinking skills within functional teams.

University of Waterloo Implementation of TBL

TBL was first employed in the University of Waterloo's Doctor of Optometry program in 2011 to supplement lectures in a third-year case analysis course. The school's four-year Doctor of Optometry program admits 90 students annually (approximately 67% are female; approximately 98% have completed a BSc or Honors BSc degree). The non-clinical curriculum is primarily delivered through didactic lectures, skills laboratories and basic science laboratories. While some instructors may use group assignments, small-group integrative teaching methods such as problem-based learning are not formally part of the curriculum. Evaluation of a program of learning is important to determine the impact on the learner.

Methods

This study followed the tenets of the Declaration of Helsinki and received ethics clearance from the University of Waterloo's Office of Research Ethics.

A paper survey was administered to 91 students in the third year of the Doctor of Optometry program; the students attended two required consecutive case

analysis courses that employed a TBL framework. The survey was administered anonymously during class time at the end of the Fall 2011 and Winter 2012 terms. The survey results were compared for the two sessions.

In the case analysis courses, lectures were supplemented with five three-hour TBL sessions held in the fall course and four three-hour sessions in the winter course. The TBL sessions accounted for 20% of the course grade in the fall term and 30% for the winter term. The individual readiness assurance test, group readiness assurance test and peer evaluation contributed to the TBL grade. The course instructor (PKH) developed the TBL sessions in 2011.

The TBL sessions were designed to closely follow Michaelsen's guidelines[3] for the teaching method. The teams were formed by the instructor to have maximum diversity using previous grade position in an optics course and a disease course. The students were aware of the process for team formation and it appeared to be successful in producing diversity within the teams. Students were given material to study one week before the sessions. At the outset of the session, the students individually took a multiple-choice question quiz of 10 to 12 questions. After the papers were collected, the teams then took the same quiz as a group using IF-AT cards until all the correct answers were known. The teams were then allowed to challenge questions, and successful challenges resulted in elimination of one or more questions. If there were any common misconceptions revealed by the quiz, a mini-lecture was given by the course instructor. A clinical case was then presented to the teams as the application exercise. Up to 10 multiple-choice questions were answered by the teams. Michaelsen et al.'s[3] '4 S' principle (same, significant, specific, simultaneous) was applied to the application exercise. Once the teams answered, they were encouraged to debate the answer among the teams. Peer evaluation also followed Michaelsen's method: Students divided points (10 X the number of other team members) between the team members.[3] At least one member had to receive more than 10 points.[3] The peer evaluation score was the average of the points awarded by the team members. The students stayed in the same teams for the two terms.

The survey items used in this study were first developed and validated by Parmalee et al.[14] in their study of medical students' attitudes toward TBL in a pre-clinical curriculum. The survey was based on the Minnesota Satisfaction Questionnaire and developed within Wright State University's Department of Communication's Organizational Communication classes over a five-year period. The survey consisted of 19 statements to which the students responded from Strongly Disagree (1) to Strongly Agree (5) on a Likert-type scale. The statements about satisfaction were grouped into five categories: Overall Team Experience, Learning Quality, Peer Evaluation, Clinical Reasoning Ability, and Professional Development.[14] The satisfaction with Peer Evaluation section was not included the first term because the students did not have their peer evaluation results at the time of the survey. Therefore, this section was added in the winter term after the optometry students had an opportunity to experience the results of the peer evaluation process in the fall term. The exact questions asked in the survey are included in **Table 1**.

The mean and standard deviation for the responses to each statement in all sections except Peer Evaluation were calculated for the fall and winter terms. Between-term differences were tested using the Mann Whitney U test at a $p=0.05$ significance level. The aggregate scores for each of the categories were calculated by averaging the means of each of the statements in that category.

Results

Of the 91 students who were given the survey, a response rate of 98% was achieved in the fall term and 95% in the winter term course. The results of the survey are presented in **Table 1**.

Optometry student satisfaction with TBL was generally favorable after the first and second course (category range: 3.75 to 4.33). Category satisfaction was highest with Overall Team Experience (4.29, 4.33) and Clinical Reasoning Ability (3.96, 4.24). Category satisfaction in the second term increased across all four categories (range 0.04 to 0.33). Regarding statements within the categories, there were significant increases in winter satisfaction with eight of the 15 statements ($p<0.038$) and no significant decreases in any category. The significant increases in satisfaction were most apparent in the Clinical Reasoning Ability category (3 of 3 statements) and least apparent in the Overall Team Experience category (1 of 5 statements).

Peer evaluation satisfaction in the second term was relatively lower than other categories (3.58). Within-category satisfaction was highest for students judging their peers' contributions to the team and lowest for liking the use of peer evaluation as part of the experience.

Discussion

Student attitudes toward an instructional method are invariably context dependent. The case analysis course at the University of Waterloo had previously used a small-group case-based learning method.[15] In this instructional strategy, small groups worked with a tutor to discuss a case and then presented the case to their peers. Several problems were noted, including "social loafing,"[3] in which some students did not contribute effectively or at all to the group work; insufficient integration of learning objectives across the group members; and variable instruction by tutors. TBL was chosen as the replacement teaching method, with the intention of addressing some of the disadvantages experienced with case-based learning.

In this study, optometry student satisfaction with learning in a team was generally favorable and it increased with greater TBL experience, particularly in the categories of Learning Quality and Clinical Reasoning Ability. This finding is supported by the work of Ofstad and Brunner,[16] who studied pharmacy student experiences with TBL. As they noted, many health professions students gain admission to their program on the strength of their individual achievement in a competitive environment. Students report negative experiences with group work and hesitate to have a portion of their grade depend upon that work. The normally higher group readiness assurance grades than individual grades in TBL can show students that teams are worthwhile and that, over time, they

Table 1
Team-Based Learning Survey Results

Question	Fall Mean	Fall Std Dev	Winter Mean	Winter Std Dev	P value
Overall Satisfaction with Team Experience	**4.29**	**0.82**	**4.33**	**0.86**	
I have found working in a team as part of my class to be a valuable experience	4.26	0.77	4.36	0.81	0.243
The other team members have generally contributed as much as I have	4.21	0.82	4.05	0.91	0.261
The team has worked well together	4.38	0.81	4.39	0.91	0.599
I have felt the other team members respected me	4.51	0.68	4.49	0.72	0.970
I have found teamwork to be a productive use of course time	4.12	0.93	4.36	0.90	0.037*
Team Impact on Quality of Learning	**3.75**	**1.03**	**4.08**	**0.94**	
I have found that the team helped me learn the course material more than if I had studied alone	3.88	1.06	4.13	0.93	0.107
I have learned more in this course than in others because I have been part of a team	3.83	0.92	4.10	1.00	0.019*
I have found being part of a team improved my course grades	3.54	1.09	4.02	0.88	0.004*
Satisfaction with Peer Evaluation			**3.58**	**0.99**	
I have found that my peers have been fair in judging my contributions to the team			4.21	0.79	
I have found that peer evaluation motivates me to work harder			3.42	1.01	
I have generally liked the use of peer evaluation as part of my team experience			3.25	1.07	
I have found that peer evaluation motivates me to work more collaboratively			3.45	1.07	
Team Impact on Clinical Reasoning Ability	**3.96**	**0.81**	**4.24**	**0.76**	
I have found that being on a team has helped me become better at problem solving	3.83	0.87	4.11	0.82	0.023*
I have found that teams make good decisions	4.01	0.74	4.30	0.69	0.009*
Being part of a team discussion has improved my ability to think through a problem	4.03	0.81	4.31	0.74	0.017*
Professional Development	**3.78**	**0.96**	**4.07**	**0.92**	
I have found that working with a team helps me develop skills in working with others	4.07	0.74	4.38	0.71	0.003*
I have found that working with a team has helped me develop cooperative leadership skills	3.88	0.83	4.24	0.81	0.002*
I have found that working with a team has helped me develop more respect for the opinions of others	3.97	0.82	4.12	0.85	0.142
I have found that working with a team has enhanced my sense of who I am	3.18	1.16	3.49	1.04	0.112

*1=strongly disagree 2=disagree 3=mixed opinion 4=agree 5=strongly agree; *significance at 0.05 level*

may develop into high functioning units.[16]

These results show a more positive aggregate score in comparison to those found by Parmelee et al.'s study[14] of medical students in all categories, except for the fall term Professional Development results. Student experience with TBL ranges across studies. A systematic review[7] of the effectiveness of TBL in health professions education found positive and neutral effects on knowledge scores and mixed learner reaction. Of the seven studies that employed a controlled comparison, Fatmi found the learner reaction favored TBL in one study. Even when the method produced superior learning outcomes, only one of four studies showed positive student reaction. It was hypothesized that this could be due to the potential for increased workload, the peer assessment component and increased accountability. Fatima found TBL satisfaction was highest when it was compared with traditional lectures rather than other small-group learning strategies. It has also been shown in other healthcare contexts that students: prefer passive lectures; dislike advanced preparatory work and the inability to skip lectures; and miss the "sage on the stage" of faculty members sharing their expertise.[16] Therefore, the favorable response of this group in this study could be a result of the primarily lecture-based curriculum and the instructor's careful attention to the amount of preparatory work required so as not to overload the students with work.

These results show that the aspect of TBL that optometry students least preferred was the peer evaluation process. Consistent with the findings of this study, students can view group evaluation processes negatively, especially when they are required to differentiate among group members and the evaluation counts toward their grade.[11,14,17] It is important that an assessment tool be reliable and valid and there is limited evidence for this in the literature.[18] Team-based learning can be conducive to peer assessment as the team members have a unique view of each other's behaviors, are capable of perceiving and interpreting the behaviors that support good teamwork and are needed to improve the team performance.[19] This component is increasingly important as performance evaluation of healthcare workers is increasingly done by patients, colleagues, administrators and inter-professional colleagues.[20] Additionally, the ability to give feedback is an important skill.[21]

In order for the full benefits of TBL to be realized, the method should be used in its entirety rather than some components that are modified to suit the instructor or institution. In order for students to embrace this method, it should integrate well with the demands of other courses in the curriculum and have administrative support. For example, the individual study that students face should not conflict with their other assignments and examinations.[17] When these conditions are met, the instructional method can produce a positive attitude about learning in teams.

The study is limited by its examination of a small sample of students over a one year period of time, thus the results may not be generalizable to other cohorts. Also, the peer evaluation component was only given once so change over time could not be determined.

Team-based learning has been a new teaching method at the University of Waterloo's School of Optometry and Vision Science. Introducing a novel teaching method into individual courses outside of a formal curriculum development plan can be met with challenges, including being able to ensure there are suitable resource supports (e.g., space, development time) for the new teaching method. Unlike lectures, many teachers have not experienced the TBL method as learners, and development time needs to be given for appropriate implementation.

TBL has gained popularity in recent years in medical education with a growing literature to support its continued use.[21] It is an active and interactive learning process that provides immediate feedback and appeals to the millennial student.[22] With its relatively new introduction into optometric education, further research on the feasibility of this teaching method is warranted. A particularly valuable area of study involves developing ways to use peer feedback effectively and decrease resistance among learners. This preliminary study suggests TBL is perceived as a positive teaching method by a group of optometry students.

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