

The educational theory basis of team-based learning

PATRICIA HRYNCHAK¹ & HELEN BATTY²

¹School of Optometry, University of Waterloo, 200 University Ave. Waterloo, ON, N2L 3G1, ²Department of Family and Community Medicine, Faculty of Medicine, University of Toronto, 500 University Ave. Toronto, ON, M5G 1V7

Abstract

Background: Health care providers require the ability to use critical thinking skills and work effectively in a team as a part of an overall set of competencies. Therefore, educational programs should use appropriate methods based in educational theory to effectively graduate learners with these abilities. Team-based learning (TBL) is a method that has been introduced in healthcare education to foster critical thinking skills while students work in high functioning teams.

Aims: This article will show how TBL follows the principles of constructivist learning theory.

Method: The principles of constructivist learning theory are discussed in relation to the teaching method of team-based learning. The effectiveness of TBL in healthcare education is then reviewed.

Results: TBL is learner centered with the teacher acting as an expert facilitator and also provides students with opportunities to expose inconsistencies between their current understandings and new experiences thus stimulating development of new personal mental frameworks built upon previous knowledge. The learning is active using relevant problems and group interaction. Teamwork skills are strengthened by focused reflection on new experiences during the group sessions and on teamwork success by providing feedback to group members.

Conclusion: Since these aspects are all essential components of constructivist educational theory, TBL is solidly grounded in the theory and is a promising method to strengthen healthcare education.

I never teach my pupils. I only attempt to provide the conditions in which they can learn.

Albert Einstein

Introduction

Health care providers require a common set of abilities to meet the needs of their patients. These abilities have been described in the Canadian Medical Educational Directives for Specialists (CanMEDS) physician competency framework within a set of roles: Medical expert, communicator, collaborator, manager, health advocate, scholar, and professional (Frank & Danoff 2007). Other healthcare professions such as pharmacists and veterinarians have adopted this framework worldwide (Frank & Danoff 2007) to guide curriculum development and competency assessment. Two of the components embedded within this framework are the ability to think critically (medical expert) and work effectively in a team (collaborator) (Frank 2005). Educators should use appropriate methods based in educational theory to effectively teach learners these competencies.

Traditional education in the health professions is centered on the teacher and the content of the courses (Peters 2000). In this didactic model, the goal is to transfer information from the teacher to the student. The focus is on the teacher, and the role

Practice points

- Healthcare professionals need strong critical thinking and teamwork skills.
- Educational programs require teaching methods that are learner centred and resource friendly.
- Team-based learning is effectively grounded in constructivist learning theory and requires only one instructor for a large group of students.
- Students apply their knowledge to solving clinically relevant problems by working actively in effective teams.

of the student is to memorize facts rather than work at the level of understanding the practical application of what they are learning (Michaelsen et al. 2008, p. 76). Recalling facts is a vital step in the process; however, students may mistakenly believe that by doing so they have gained a true understanding of the material and will be able to apply the information in a novel context (Michaelsen et al. 2008, p. 77). An alternative educational method, called dialectic teaching, is the practice of logical discussion used when determining the truth of a theory or opinion (Michaelsen et al. 2008, p. 77). Team-based learning (TBL) is a form of dialectic teaching developed by

Correspondence: Patricia Hrynchak, School of Optometry, University of Waterloo, 200 University Ave. Waterloo, ON, N2L 3G1. Tel: 519-888-4567 X 32754; Fax: 519-746-4365; E-mail: hrynchak@uwaterloo.ca

Larry Michaelsen and adapted to health care education in the last two decades (Michaelsen et al. 2008, p. 5).

Students need to learn and apply the power of reason gained through critical thinking before offering viewpoints and to apply this same approach when evaluating statements made by others. The extent to which a person accomplishes this process defines his or her competency in a given field. (Michaelsen et al. 2008, p. 80)

In this article, we explore how well team-based learning is grounded in educational theory. We review the constructivist theory of education as it applies to TBL used in the development of critical thinking and team-work skills among health professionals.

Constructivist theory

Epistemology is the division of philosophy that examines the nature of knowledge (Hunter 2008). In constructivist epistemology, knowledge is viewed as a process that is structured by personal experiences. New experiences are used to add to and modify previous understandings (Pelech & Pieper 2010). The concept of truth is replaced by that of reality, which is a view of the world that the individual builds through experience (Peters 2000). Therefore, in this theory, “knowledge is an autonomous and subjective construction” (Pelech & Pieper 2010). In contrast, positivism purports that “knowledge and truth exist outside the mind of the individual” (Peters 2000). Positivist knowledge is, therefore, fixed and can be transferred from one individual to another (Peters 2000).

During the first half of the twentieth century, researchers developed two main learning theories: The behaviorist and the cognitive theory (Mohanna 2010, p. 45). In the behaviorist view, learners are passive and a stimulus produces a reaction in the learner. In the cognitive view, the learners think about the information, process it, and then act upon it in different ways depending on the situation (Mohanna 2010, p. 45).

Constructivist learning theory is a refinement of cognitive learning theory and is derived from constructivist epistemology where the “focus is on the mental representation of information by the learner” (Svinicki 2004, p. 242). The learner reconstructs long-term memory representations to be consistent with new information from the environment and experience (Svinicki 2004). For this to occur, learners must process the new material and integrate it with existing understandings to form a new cognitive structure that is unique to them based upon their own process of learning (Moon 2004).

The four main principles of applying the constructivist theory to educational methods are summarized in Table 1. First, the focus of the learning is on the learner rather than the teacher. An opportunity to focus on the learner's ideas and questions should be provided. The instructor's role is one of expert facilitator where the student takes the active central role in learning (Hunter 2008). These environments are egalitarian, nonhierarchical and nonauthoritarian. There is an acknowledgement that “learning is a two-way process between the teacher and the learner” (Davies 2000). As knowledge is built by making sense of prior experiences, the role of the teacher is to

Table 1. Summary of the main elements in constructivist learning (Kaufman 2003).

1	The teacher is a guide to facilitate learning.
2	Teaching involves providing opportunities to expose inconsistencies between learners' current understandings and new experiences therefore providing the opportunity to develop new schemes.
3	Learning should be active using relevant problems and group interaction.
4	Time is needed for reflection on new experiences.

provide opportunities to challenge previously held opinions and understanding (Peters 2000; Torre et al. 2006). The instructor is also a mediator between the curriculum and the student, allowing the two to interact in a meaningful way (Peters 2000).

Second, in constructivist learning theory, problem-solving plays a central role. The problems need to be of immediate relevance to the needs and interests of the learner and challenge previously held constructs. Learning based on previous experience and solving problems requires the ability for self-direction on the part of the learner. Guidance from teachers or fellow learners can provide scaffolding for learners to support them until they achieve full self-direction (Davies 2000). Within this framework, the learners' awareness of their learning process and the ability to control those processes is enhanced. This is called metacognition and is the basis for self-direction in learning (Peters 2000).

Third, in social constructivist theory, there is a strong emphasis on learning with dialogue and interaction with other learners as well as the development of a common understanding that is achieved by experiencing the world together (Svinicki 2004). The best constructivist instructional methods, therefore, will provide new experiences through opportunities to work with other students (Svinicki 2004). For example, students could work in small groups on problems derived from relevant real life experiences.

Finally, reflection is required to allow the learners to make judgments on when and how to modify their existing knowledge. Reflection can be of two kinds: Reflection in action and reflection on action. “Reflection in action” occurs immediately by applying current and past experience to novel experiences as they are happening. “Reflection on action” occurs when the person recalls what happened, what contributed to it, whether the actions taken were optimal and how this information may be used to enhance future practice (Mohanna 2010, p. 66) (Table 1).

The principles of the constructivist approach to learning have been used in a variety of health care training programs (Davies 2000). Classic problem-based learning is one of the earliest applications of this theory. In this approach, the curriculum is organized around problem-based small group tutorials, inquiry seminars, clinical skills training, clinical experience, independent study, and interprofessional education (Davies 2000). This method was originally introduced in Canada at McMaster's School of Medicine, but is now used either as a main educational format or an additional format in medical schools and other health care training programs

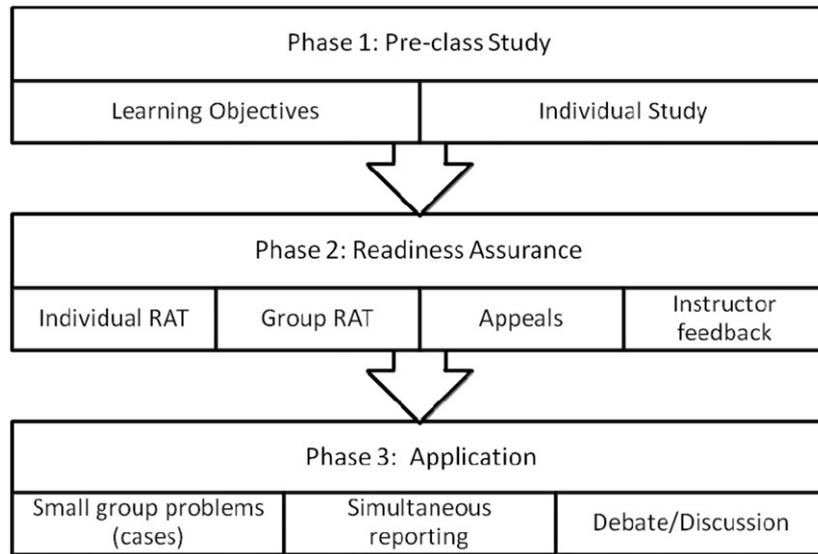


Figure 1. The diagram represents the three phases of the team-based learning process. RAT = readiness assurance test. The first phase is preclass study with the instructor providing the materials for individual study based on the course learning objectives. The second phase is readiness assurance where students take an individual test and then the same test in their team. Appeals of any questions perceived to be unfair are heard. The instructor then addresses any misconceptions held by the class. In the third phase, the teams work on application exercises which are case problems with questions to answer. The teams report their answers simultaneously and then debate or discuss their answers.

in Canada, the United States and many other countries (Davies 2000). While the approach has shown promise, research in the effectiveness of this teaching approach has thus far yielded a lack of strong evidence of enhancement of learning, perhaps due to a lack of appropriate outcome measures (Hartling et al. 2010; Polyzois 2010). In addition, problem-based learning is resource intensive due to the low faculty-to-student ratios in the small group process (Walton 1997).

Team-based learning

TBL was originally developed by Larry Michaelsen for instructing business students in the 1970s (Michaelsen et al. 2008). TBL is an active learning method that is learner centered but instructor led (Koles et al. 2010). It fosters individual and group accountability as groups of five to seven students work together to solve clinical problems.

This method is used for large classes that are divided into smaller groups (referred to as teams) that have maximal diversity within the teams but relative evenness between the teams. This is accomplished by deciding what the key characteristics of individual members are that would promote success of a team and then distributing people with these qualities evenly between the teams (Michaelsen et al. 2008). In that way, each team has a maximal diversity in the knowledge and experience of the members that can be drawn upon when collaboratively solving the analysis problems.

The instructor sets the learning objectives and purposefully designs the course into modules that will address those learning objectives. The modules consist of three repeating phases (Figure 1). The first phase involves a prior learning assignment where the students study material in advance of

the learning session that has been assigned by the instructor (Michaelsen et al. 2008).

The second phase focuses on readiness assurance and has four steps. Initially, the students take an individual readiness assurance test (IRAT). This is a multiple choice test that assesses concepts from the prior learning assignment. The focus of the test is on recall of factual material rather than application. After the students individually complete the test, the team then takes the same test as a group. This is referred to as the group readiness assurance test (GRAT). Using an immediate feedback assessment technique (IF-AT) the group members work together on the answers until all of the answers are correct. The IF-AT is a scratch card that contains the correct answer for each question. The groups will normally perform better than the highest score of any individual member (Nieder et al. 2005; Vasan et al. 2008; Parmelee & Michaelsen 2010). The students are next allowed to appeal in writing any questions that they do not feel are fair. Each challenge is considered by the instructor. In the final step, any outstanding misconceptions around the content are addressed by the instructor (Michaelsen et al. 2008).

In the third phase of the process the students work in the same teams to solve problems that are based on the material that has been learned. These are called application exercises. The problems are designed to have the following characteristics; they 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. The problems have multiple solutions that allow for debate of the correct answer. The teams then defend their answer to other teams, who have chosen a different answer. The instructor

facilitates the discussion between teams (Michaelsen et al. 2008).

An important component of TBL is the group evaluations. Team members give feedback to the other group members on team performance once or twice during the course. This allows the students to practice giving and receiving feedback to members about their ability to work in the productive team (Michaelsen et al. 2008).

Theoretical grounding of TBL in constructivism

An important question to explore is how well does TBL follow the principles of constructivist learning theory? In TBL, the teacher acts as a guide to learning by setting the educational objectives and developing study materials, tests, and appropriate problems for the groups to solve. The instructor guides discussion that is generated by the learners. Strategies providing passive learning such as lecturing are reduced in this process. Student centered principles and supportive scaffolding important in constructivist learning theory are consistently inherent.

TBL allows learners to compare their current understandings with those of the group and debate controversial points in the GRAT and group application exercises. This is consistent with a constructivist view that learning occurs by integrating information obtained by new experiences into existing mental schemes.

As an active learning method TBL requires the students to actively engage with one another and the material in solving problems. The group application exercises are real world problems that occur in the clinical practice. Critical thinking is modeled and learned in this active process.

Reflection in action occurs when students compare their understanding to that of the group during the GRAT and in solving the case problems in the application exercises. New connections are made by exposing these inconsistencies in understandings. When the students are required to evaluate the contributions of all the team members it is a form of reflection on action. Learners also reflect on the feedback they receive from other group members on their own performance as team members.

Team-based learning in healthcare education

TBL is being used in the education of physicians, nurses, dentists, veterinarians, and other health care professionals in schools in the United States and at least six other countries (Parmelee 2010). Research has shown positive outcomes including the development of critical thinking skills, team work enhancement, better quality of in class discussion, as well as optimal learning outcomes (McInerney & Fink 2003).

TBL is an effective way to improve “critical thinking skills by exposing thought patterns to peers for constructive criticism” (Walton 1997). Hake has shown that using interactive engagement techniques, such as those used in TBL, enhances problem-solving abilities (Hake 1998). Parmelee et al. (2010) found that students felt that being on a team “helped them be a better problem-solver, that teams

make good decisions [and] that being on a team improved their ability to think through a problem” (Parmelee et al. 2009, p.4).

There are several features of high-functioning teams. These include high levels of involvement by all members, team identification and the ability to use complex thought processes (Thompson et al. 2009). TBL fosters these attributes by encouraging true teamwork toward a common goal with each student facilitated in contributing to that goal and by sharing a group grade (Morrison et al. 2010). Davidson found that there was a significant increase in the students’ estimation of their “understanding of the principles of group work” over time using TBL (Davidson 2011). In a psychiatry clerkship, student attitudes about the value of working in teams increased following their instruction using TBL despite having considerable prior exposure to other small group methods (Levine et al. 2004).

Student achievement can be quickly assessed and promising studies show the impact of TBL on students’ performance on examinations. Medical students on average performed better in comprehensive course examinations in pathology on content learned using the TBL method than on content learned using other teaching methods such as lecturing. Very importantly, the students who were in the bottom quartile of the class showed more improvement in performance than those in the highest quartile (Koles et al. 2010). Students in a psychiatry clerkship performed significantly better on the National Board of Medical Examiners (NBME) psychiatry subject test following the implementation of TBL in the curriculum (Levine et al. 2004). Chung et al. found that in learning medical ethics, student performance on examinations improved especially for the academically weaker students (Chung et al. 2009). Similar results have been found in other studies (McInerney & Fink 2003; Nieder et al. 2005; Vasan et al. 2008; Zgheib et al. 2010; Thomas & Bowen 2011).

There is accountability on the part of the individual learners with a reduction in “social loafing” (i.e., reduced opportunity for avoidance by students of advance preparation and engagement in the group work) (Michaelsen et al. 2008, p. 104; Koles et al. 2010). Faculty members generally see an improvement in students’ preparation, attendance and quality of class discussions (Thompson et al. 2007a). Hunt et al. (2003) used external observations during the TBL sessions and found a relatively high level of engagement of the students compared to lecture based courses. Levine et al. (2004) found that students rated TBL “significantly more effective and enjoyable than traditional didactics.”

While the research support for TBL is building, there are also some limitations (Thompson et al. 2007b). For TBL to be effective there must be buy-in from faculty, students and the administration. There must be expertise and training in the technique as well as time provided in the curriculum and for the faculty member to do the development. While teaching personnel resources are less than in case-based learning, other resources are required such as space, materials and administrative support. The size and content of the course is also important (Thompson 2007b).

TBL requires significant instructor effort to make the assignments useful with an optimal amount of complexity

(Parmelee 2010; Zgheib et al. 2010). There may be a potential lack of engagement by instructors if the method is imposed on the system with insufficient resources (Thompson et al. 2007b). Several studies have found that students have lower levels of satisfaction with TBL than other teaching methods such as small group or lecture (Hunt et al. 2003; Haidet et al. 2004; Willett et al. 2011). However, Davidson found that the acceptance of active learning strategies can increase over several years (Davidson 2011). Students can also have difficulty with the group evaluation process, especially when they are required to differentiate among group members and the evaluation counts towards their grade (Nieder et al. 2005; Thompson et al. 2007a; Parmelee et al. 2009). Also, the method may not integrate well with the demands of other courses in the curriculum. For example, the individual study might conflict with other assignments and examinations that the students are required to do in other parts of the curriculum (Thompson et al. 2007a).

Thus, the application of any teaching method to an individual program can be influenced by local factors such as space, faculty time available, engagement of faculty and students and other demands of the curriculum. If adapting the method to the local context transforms the method especially in any of its important elements it will impact on the success of the technique (Varpio et al. 2011; Parmelee & Michaelsen 2010).

Conclusions

Healthcare educators are aware of the limitations of didactic methods for developing critical thinking skills in learners. Newer approaches grounded in constructivist principles are showing promise in teaching effectiveness research. TBL is an effective and economical teaching method based on constructivist learning principles. It enables students to develop critical competencies of critical thinking skills and teamwork abilities. Using methods based upon sound educational theory is an important factor in maintaining accreditation in most healthcare training programs. There is an opportunity for more study on this method to confirm recent results. Specifically, important topics for future research include looking at the effect of TBL on problem-solving abilities and investigating ways of increasing acceptance of the method by the students. Applying new techniques must be done carefully so as to avoid unwanted consequences such as a decline in the students' performance on board examinations due to a misalignment of the teaching methods and assessment format. Changes in teaching methods must be carried out with sensitivity to the broader regulatory and professional environment. New methods can be looked at skeptically by associations and colleges from within or outside the individual profession that may not be familiar with optimal teaching methods. Using methods grounded in educational theory in healthcare training programs may provide an impetus for regulatory colleges to utilize reflective methods when designing their maintenance of competency programs. TBL is a relatively new educational method that is grounded in theory and promises to be an important adjunct to existing methods.

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Notes on contributors

PATRICIA HRYNCHAK, OD, FFAO, is a clinical faculty member at the University of Waterloo, School of Optometry. She is involved in curricular renewal and has a special interest in optimal methods of teaching critical thinking skills.

HELEN BATTY, MD, CCFP, M.Ed, FCFP, is Professor and faculty member of the Department of Family and Community Medicine, University of Toronto. She is also the Founding Director for the Department of the Academic Fellowship and the Graduate Studies programs.

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