

REVIEWS

Team-Based Learning in Pharmacy Education

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Instructors wanting to engage students in the classroom seek methods to augment the delivery of factual information and help students move from being passive recipients to active participants in their own learning. One such method that has gained interest is team-based learning. This method encourages students to be prepared before class and has students work in teams while in the classroom. Key benefits to this pedagogy are student engagement, improved communication skills, and enhanced critical-thinking abilities. In most cases, student satisfaction and academic performance are also noted. This paper reviews the fundamentals of team-based learning in pharmacy education and its implementation in the classroom. Literature reports from medical, nursing, and pharmacy programs are also discussed.

Keywords: team-based learning, active learning, readiness assurance, student engagement, critical thinking, communication, small groups

INTRODUCTION

Over 100 years ago Abraham Flexner provided his seminal report on the state of medical education in the United States and Canada.¹ Among the important findings from the evaluation of the 155 medical education programs in existence, was that medical students were not being educated properly to fulfill the societal needs of medicine in the early 20th century. Although directed at medical education, the deficiencies noted are important for the education of all healthcare professionals. Some of these deficiencies are presently addressed in substantive ways, such as prerequisite education, learning foundational and clinical sciences as integrated courses, and significant practitioner-patient interactions. These aspects are so commonplace in current curricula that their omission would seem extraordinary. One deficiency noted by Flexner that has been quite recalcitrant to change over the past 100 years is how content is delivered to students. In his report, Flexner noted that passive lectures are ineffective and that active learning is essential for student education. Despite this insight over a century ago, lectures still prevail as a common means of classroom instruction in the healthcare professions today.

There has been increasing interest among healthcare educators in engaging students in active learning and moving away from strictly presenting technical content

followed (often weeks later) by an examination.²⁻⁴ The incorporation of active-learning strategies in the curriculum is part of the accreditation standards for doctor of pharmacy (PharmD) programs.⁵ There is ample evidence that passive lectures provide the lowest level of knowledge retention and cognition.⁶ Thus, active-learning methods, which help develop problem-solving and critical-thinking skills and provide a higher level of cognitive functioning leading to a greater degree of understanding and retention, should be embraced at all levels of the curriculum.^{7,8}

Two notable team-oriented active-learning strategies implemented in healthcare education over the last few decades are team-based learning and problem-based learning. As opposed to passively listening to content presentations given by a lecturer, team-based learning and problem-based learning rely on active participation in the classroom and student discussion in small groups. In problem-based learning students engage in a challenging problem in class and use a series of progressive disclosures and small-group facilitated discussions to identify gaps in students' understanding and need for further self-directed research. In contrast, team-based learning requires students to acquire foundational knowledge prior to class by completing clear instructor-developed unit objectives, advanced preparation assignments, and student readiness assessments. Instructor facilitation also differs between the 2 strategies, with the team-based learning instructor facilitating a classroom discussion once all groups have submitted solutions, while the problem-based learning instructors facilitate each group during the problem-solving phase. This results in a significantly smaller

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number of instructors needed with team-based learning (1 facilitator per classroom) vs problem-based learning (1 facilitator per group). Both pedagogies stress critical thinking, communication, student accountability, and engagement in learning.⁹

This review focuses on delivering team-based learning in healthcare education in general and pharmacy education in particular, including the principles essential to successful team-based learning implementation, the elemental phases of a team-based learning unit, and reports in the healthcare education literature that describe the successes and challenges of this dynamic teaching platform.

A search of the peer-reviewed literature was conducted and articles describing the use of team-based learning in healthcare education in both classroom and experiential settings were evaluated. The databases OVID and PubMed were searched using the terms “team learning” and “team-based learning” to find articles. The time limits of the search were from the inception of the databases through August 2012. The authors examined the search results and selected articles based on the inclusion of the foundational aspects of team-based learning, such as readiness assurance, application exercises, appeals, and peer review.¹⁰ Articles that focused on students learning in teams without the basic elements of team-based learning were excluded.

FUNDAMENTAL PRINCIPLES OF TEAM-BASED LEARNING

Adopting team-based learning in the classroom requires a significant change in the approach to teaching and learning by both instructors and students. There are 4 principles that are essential for successfully implementing team-based learning in the classroom.^{9,11} The first principle is that teams must be carefully formed and managed. The key features of team formation are permanence, diversity of resources, and ability to communicate clearly. Permanence allows for team dynamics, expectations, and trust to develop as groups of divergent students evolve into high-functioning teams. Diversity of resources, such as education, experience, and cultural background, help instructors stratify student teams so that there is a balance of perspective among all teams and no particular team is advantaged or disadvantaged. Balanced communication among team members is often difficult to ensure as some students tend to assume their familiar roles of not contributing or over-contributing to the dialog. Careful instructor oversight and coaching is often necessary to motivate low-performing teams and is quite effective with students who are new to team-based learning and struggle with how to communicate in a team environment.

The second fundamental principle of team-based learning is that students must be accountable for individual and team work. Peer accountability is critical to team building and survival. In addition to the quality of the team’s work, individual team members must be accountable for their preclass preparation, classroom learning, and constructive team participation. This accountability is reinforced through the readiness assurance process with each new unit, which is followed by regular team assessments and periodic formal peer evaluation, generally occurring at the midpoint and completion of the course.

The third fundamental principle is that students must receive frequent and timely feedback from faculty members. In team-based learning, feedback is provided to individuals and to teams through the readiness assurance process where the readiness assessment test for individuals (iRAT) and teams (tRAT) at the start of the classroom session for each learning unit. Feedback for the iRAT and tRAT can be provided by immediately discussing answers following the assessment or through the use of an audience response system or scratch-and-reveal answer cards. Feedback following the application exercises is generally accomplished through instructor-facilitated discussion in the classroom that encourages inter-team interactions to foster critical thinking and dialog. Some instructors also provide feedback to students as part of the peer-review process. Instructors rely less on prepared material and instead adapt and redirect feedback towards desired learning outcomes. This shifts the role of the instructor in the classroom from content delivery to identifying gaps in understanding and challenging students with follow-up questions. This role is often referred to in team-based learning literature as moving from “sage on the stage” to “guide on the side” and highlights the deemphasized voice of the instructor and reemphasized voice of the student in communicating and defending solutions in classroom discussions.

The fourth principle is that team application exercises must promote learning and team development. One challenge in creating team application exercises is to craft them in a way that encourages interaction through the use of fundamental course concepts to make and defend a decision. Learning is enhanced and team building occurs when teams are required to use their collective knowledge, skills, and values to choose a specific solution and defend their choice.

LEARNING PHASES OF TEAM-BASED LEARNING

Once teams are formed, the instructor introduces the first learning unit. Individual units may vary in length but generally require from 2 to 10 hours of classroom time to

complete. Content requiring long periods of time in the classroom typically necessitates extensive preclass preparation as well, and that may inhibit individual readiness, leading to student and instructor frustration. Instructors need to strike an acceptable balance between the extent of preclass material assigned and the amount of time students have for preparation. The instructional unit in team-based learning is implemented in 3 phases: preparation, readiness assurance, and application.

Phase 1: Individual Preparation

Unlike a traditional lecture-driven course, the team-based learning instructional unit begins before students come to class. Team-based learning requires students to arrive in class familiar with the fundamental knowledge and background necessary for progression through the learning unit. This preclass learning is directed by the instructor through a preparation assignment for each unit. These assignments often include literature articles, textbook sections, and/or instructor-prepared handouts. Critical to the students' successful preclass learning are clear, concise learning objectives written by the instructor to guide the student through the new instructional material. To allow students enough time to engage the preclass material, the assignment should be given well in advance. Supplementary materials, such as prerecorded lectures, slide sets, or practice exercises, may be included that help students to focus on the learning objectives.

The time necessary for students to prepare for a given unit needs to be considered carefully. Learning new and sometimes complex content prior to class may require more time than anticipated. This may be especially true for students who are not used to coming to class well prepared to engage in active learning. Students new to team-based learning will require time to adjust or change how they study. Instructors should be careful to create meaningful readiness assignments that are not overwhelming or unfocused, as students may not complete or only skim the material if relevance is not apparent. This is particularly germane if team-based learning will be used in other courses in which the students are enrolled during the same quarter or semester.

Faculty members should not expect students to master all content as part of the preclass preparation. Rather, faculty members should use the preclass preparation to guide the students through the most powerful and fundamental concepts so that these concepts can be applied and built upon during the classroom exercises.

Phase 2: Readiness Assurance

Readiness assurance is a critical component to using team-based learning successfully. Without a readiness

assurance process, it would be difficult to engage students in learning material prior to class in order to be adequately prepared to participate in class. As is clear from traditional lecture courses, students without incentive rarely study in advance and some do not even attend class. In fact, one of the advantages of team-based learning is that the readiness assurance process results in excellent class attendance.⁹ Students are motivated to be prepared and engage in the readiness assurance process because they are graded on their performance.

For most team-based learning instructors, readiness assurance takes the form of each student taking a short test, or iRAT, at the beginning of each new unit. The iRATs are collected and then the same test is distributed to the teams and each team is given time to discuss and select the best answers for the tRAT.

Once completed, tRATs are collected by the instructor, who then transitions into a discussion facilitator role. This is commonly referred to as the "mini-lecture" in the team-based learning literature, although the term may be somewhat misleading. This "mini-lecture" works best as an interactive discussion among the teams, initiated and guided by the instructor. Throughout the discussion, the instructor provides feedback and focuses the class on the fundamental and powerful learning concepts, as well as any significant readiness concepts unclear to the class. Experienced team-based learning instructors preview the iRAT results while the team is engaged in the tRAT to anticipate where reinforced understanding is needed and follow-up questions should be focused.

Phase 3: Application of Key Concepts

In the team-based learning classroom, the highest level of learning occurs during the application exercises. These exercises are team activities that build on the readiness materials and encourage students to engage the content at a deeper, more meaningful level. The application exercises help students achieve the learning objectives for the unit through the careful evaluation of problems or cases that require critical thinking and investigation to solve. Application exercises that force teams to select a single best solution are the most engaging and beneficial for the students. The use of constructive controversy when creating application exercises can lead to robust discussions and offer an excellent opportunity for deeper learning.¹²

The successful design of application exercises starts with a backward design. Developing the application exercises to target the skills, knowledge, and values for the learning unit helps the instructor use the classroom time efficiently and assign appropriate preclass material for the students. Effective application exercises for team-based learning generally follow what is commonly referred to

as “the 4 S’s.” First, application exercises should be designed around problems that are *significant* to the students. When students are able to attach relevance and value to a problem it becomes significant and meaningful to them, which leads to deeper learning. Second, teams should be working on the *same* problem. This allows for discussion among teams following the completion of the exercise and provides students the opportunity to hear their teammates’ responses. Third, teams should be required to make and defend a *specific* choice. This action helps teams develop consensus-building and critical-thinking skills. Finally, teams should *simultaneously* report their choices to the class. This action promotes team accountability and motivates teams to defend their answers. This also eliminates the phenomenon with sequential team answering where the first team’s answer has a potent effect on subsequent answers.

Following each application exercise, instructors provide guidance and feedback as part of the class discussion before advancing to the next application exercise. These discussions are similar to those at the end of the readiness assurance process where the intent is to ensure that students understand the fundamental concepts up to that point. Instructors will often further the discussion among teams regarding differing answers or dissimilar approaches and share how they arrived at their answer and why their answer is best.

Appeals

To diminish students arguing with instructors over points or about the interpretation of a question, an appeals process should be part of a team-based learning curriculum. As part of the appeal, a team provides evidence and creates a cogent written argument as to why their answer on a tRAT or application exercise is correct. This process gives students an opportunity to think differently about problems and examine alternative solutions for authenticity. This appeals process also reinforces the principle that, especially in health care, multiple solutions with varying degrees of correctness may exist for a problem.

Appeals are generally submitted as written, evidence-based petitions to the instructor following the tRAT or application exercises and must be submitted within a pre-specified time period. The instructor normally reviews the appeals outside of the classroom and returns a response to the team by the following class period. The response to an appeal, which may include further discussion or requests for additional student research, is an excellent learning opportunity for students and gives the instructor another tool for teaching. The appeals process also affords the instructor an opportunity to revise RATs and application exercises for future use.

Additional Assessments

Team-based learning pedagogy is largely silent on how the instructor and student should follow up on learning after an instructional unit is completed. Quite often instructors put the unit behind them until summative assessments, such as midterm and final examinations, are scheduled. Even though the readiness assurance process drives students to think in advance about content, students also tend to wait for the summative assessment to review past learning units. However, if students did not understand the key learning concepts when they were initially presented, they may struggle again with the material when preparing for subsequent assessments.

The principle of scaffolding, as described by Wood, Bruner, and Ross, promotes student mastery of skills and knowledge by providing sufficient time and structure for students to internalize knowledge, with gradual removal of instructor support.¹³ An assessment approach to team-based learning delivery that applies scaffolding principles is the addition of individual and team cumulative assessment tests (iCATs and tCATs) periodically to the team-based learning course.¹⁴ CATs, which often appear to students as “mini-midterms,” serve as formative assessments, providing feedback on students’ cumulative understanding across multiple team-based learning units in a low-stakes manner. Periodic cumulative assessments encourage students to organize and consolidate learning gained through prior self-study and team-based learning classroom applications.

Other types of supplemental assessments that can be valuable educational instruments are student self-evaluations and reflection papers. These tools can be useful as part of the peer-review process and help students develop a better understanding of their role as a member of the team.

APPLICATION OF TEAM-BASED LEARNING IN HEALTHCARE EDUCATION

Medicine

The most active users of team-based learning in healthcare education have been medical schools. In the foundational sciences, team-based learning has been used to teach medical students such varied topics as physiology,¹⁵ pathology,¹⁶ pharmacology,¹⁷ neurology,¹⁸ and anatomy.¹⁹⁻²¹ Seidel and Richards reported that in addition to increased student engagement, there was an impressive level of student reasoning when teams were discussing physiology problems.¹⁵

Koles and colleagues reported that the most attractive feature of team-based learning was the ability to harness the resources of students who were well-prepared to engage in the exercises and assist their peers in the

learning process.¹⁶ They also reported that although there was no significant difference in overall student performance on examination questions between team-based learning and case-based discussion groups, students who performed in the lowest quartile had better knowledge retention from the time of the active-learning event and examination. Thus, team-based learning may particularly benefit students with lower academic achievement.

This selective benefit was also noted by Tan and colleagues when using team-based learning to teach neurology.¹⁸ The authors reported that team-based learning provided improved knowledge for all students as compared with passive learning. There was, however, particular benefit to those students who were academically the weakest. Nieder and colleagues found similar benefit from team-based learning to academically at-risk students in a medical gross anatomy and embryology course.¹⁹ Student performance on iRATs was found to be a strong predictor of major examination performance. Interestingly, while the overall mean examination scores were not different from those from previous years, following the introduction of team-based learning, the distribution of lower grades was narrower, resulting in fewer failing grades.

Bick and colleagues used team-based learning to integrate the foundational sciences with clinical experiences in order to improve student communication skills and the ability to work on a team to solve clinically relevant problems.²² The instructors reported that the clinical cases presented in team-based learning format were effective at integrating the foundational sciences with the clinical application of knowledge. The instructors also reported that students may have perceived the iRATs as being summative rather than formative assessments. Some of the students regarded the preparatory reading as unnecessary and a task that would have been better received as part of the actual clinical case. The authors reflected that this comment was likely the result of students who were used to lectures and not accustomed to learning material in advance of its application as is done in team-based learning.

An evidence-based medicine course was taught to second year medical students using team-based learning.²³ Hunt and coworkers reported that the use of team-based learning resulted in a high level of student engagement, whether that interaction was between students or with an instructor. However, students did not favor team-based learning. The students' limited enthusiasm was attributed to a discomfort with working in learning teams and a preference for listening to lectures. Also, students found the preparation required for class was an intrusion on their already busy schedules. The

necessity of attending class in order to participate was undesirable for students who had developed the habit of skipping classes in prior courses.

Team-based learning has also been useful in teaching ethics to medical students.^{24,25} Kim used team-based learning to teach a course on research and publication ethics and found that students had positive comments about knowledge gained and noted students' willingness to share what they learned with their peers.²⁴ The students also reported that team-based learning helped understanding course content and their ability to communicate with others. Chung and colleagues reported similar findings regarding increased content mastery by the student teams relative to individuals.²⁵ Like the articles cited earlier in this review,^{15,16,19} both of these reports indicated that team-based learning was particularly beneficial to students who were struggling academically.

Team-based learning has been used outside the classroom in medical education as well. Ravindranath and colleagues used team-based learning to teach medical students during a psychiatry clerkship and, in doing so, demonstrated that residents and fellows were effective team-based learning instructors.²⁶ In an ambulatory medicine clerkship, Thomas and Bowen reported that performance among students who were taught using team-based learning improved more than among students taught using small group lectures.²⁷ Despite the improvement in knowledge, some students felt that replacing lectures with active learning was equivalent to the faculty members withholding their expertise.

Levine and coworkers published 2 reports of using team-based learning during clinical clerkships for medical students.^{28,29} Following the use of team-based learning, students performed significantly better on the psychiatry subject test for the National Board of Medical Examiners and their attitudes about working in teams improved as well.²⁸ Students also commented that team-based learning led to a more enjoyable and engaging learning experience and greater learning effectiveness as compared with traditional lectures.

Three years later, Levine and associates examined whether peer evaluations following team-based learning correlated with student performance measures such as quizzes, clinical scores, and national board examinations.²⁹ Although the correlation was modest, the use of team-based learning did lead to improved outcomes for the clerkship students. The authors noted improvement in other noncognitive qualities that were also important factors in peer evaluation; namely, individual preparedness and contributions to team discussions.

The student response to peer evaluation was less positive. Students shared an initial dislike for the peer

evaluation system; however, once the requirement of discriminatory grading (requiring students to grade at least 1 teammate as “above average” and at least 1 teammate as “below average”) was removed, student satisfaction increased.

Medical residents have also been trained using team-based learning.³⁰⁻³³ In 2002, Haidet and colleagues tested the use of a team learning approach to teach internal medicine residents during a noontime lecture period.³⁰ Although only containing some of the components of more traditional team-based learning, the residents reported increased engagement and a favorable change in attitude about the usefulness of the content discussed. Similar results were reported by Touchet and Coon for medical residents in a psychodynamics course.³²

Faculty members responsible for initiating team-based learning for a primary care residency for training practitioners for screening and intervention for alcohol misuse found that team-based learning was well received by residents who preferred it over traditional lectures.³³ The faculty members did note, however, that the planning and preparation for resident activities was labor intensive.

Although much of the literature reports knowledge improvement following the implementation of team-based learning in the health sciences curriculum, not all academic centers have had such success. Zgheib and colleagues used team-based learning to instruct fourth-year medical students in clinical pharmacology. Individual performance on examinations were not improved following the intervention.³⁴ Similarly, Willet and coworkers compared the use of team-based learning to small-group learning and found that for students learning clinical pathophysiology, there was no difference in examination scores between the 2 methods of teaching.³⁵ Although no improvements in examination scores were reported in these 2 studies, neither was a reduction noted. This supports the premise that while team-based learning may not be beneficial in some settings, there does not seem to be a detrimental effect on student learning.

Nursing

In 2008, Feingold and colleagues reported the results of implementing team-based learning in a first semester clinical nursing course in a baccalaureate nursing program in order to enhance the students’ clinical reasoning abilities and collaborative practices.³⁶ The authors replaced 6 of 14 traditional lectures with team-based learning sessions following the principles of Michaelsen and colleagues.⁹ The instructors evaluated student engagement in the classroom using the STROBE classroom observation tool by trained observers.³⁷ The authors reported that 84% of the time the students were engaged

in the instructional activity, primarily, through interactions among team members. This peer-assisted education supports the aim of developing active learners in a team environment that is so valued in the current healthcare environment. Even though students recognized the value of learning through discussion with other team members and the importance of this step in developing critical thinking skills, they reportedly struggled with ambiguous questions and were apprehensive about how team learning related to their course grades.

Clark and colleagues reported the effect of changing 4 of 8 modules in an undergraduate nursing course, Case Management for Older Adults, from traditional lectures to team-based learning.³⁸ Using a traditional lecture-based nursing pharmacology course as a comparator, students reported that they participated more with the team-based learning format, but found it less enjoyable. A decrease in satisfaction may have been a reaction to the novelty of the readiness assurance process, namely having to learn material prior to class without prior presentations to outline specifically what should be learned. While such a change in learning may cause apprehension, a reasonable amount of preclass reading with clear learning objectives may have provided the students a higher level of comfort.

Andersen and colleagues implemented team-based learning in 4 large classes for second-year students in a baccalaureate nursing program.³⁹ Initiating team-based learning in the courses was anxiety provoking for faculty members who were not familiar with the process or classroom logistics and thus required a significant amount of planning prior to the start of the team-based learning sessions. Despite this anxiety, collegial support was critical for success, including debriefing after sessions in order to capture students’ initial perceptions and mitigate potential problems. In addition, faculty members reported feeling uncomfortable when confronted by students frustrated with the team-based learning process and not comfortable in their new role as active learners.

Students expressed discomfort when working on patient care cases where more than 1 answer was possible and instructors did not provide a single correct answer for the students to learn. Nonetheless, the faculty members noted that students asked questions at a depth and scope that was much richer than previously. Other benefits of team-based learning included a reduction in assigned readings, provision of guides to direct students’ focus during the preclass preparation, and reduced attrition.

Pharmacy

Letassy and colleagues were one of the first to report the use of team-based learning in a PharmD program.⁴⁰ To increase students’ ability to think critically and apply

information to solve patient cases, faculty teaching an endocrine module replaced a primarily lecture-based format with team-based learning. The use of team-based learning afforded the instructors the opportunity to shift much of the factual content delivery (ie, what would be dispensed as a lecture) to the pre-class preparation guided by well-developed learning objectives from faculty members. This allowed more classroom time to be spent solving problems rather than passively receiving content. The instructors were able to reduce the time spent in the classroom by 40% without negatively affecting student outcomes.

Following the team-based learning endocrine module, unit examination grades improved from 81% to 86%. In addition, there was a greater percentage of students earning a course grade of A (23%) compared with the previous year (9.5%) in which a lecture format had been used, and no students earned a course grade of D or F. The authors reported that team contribution and iRAT scores were significantly predictive of students' overall course performance, whereas tRAT, team case responses, and unit examinations were not. These results underscore the importance of the readiness assurance process and how essential it is for students to appreciate the need to be prepared for participating in class.

In order to improve students' problem-solving approach to patient care while integrating topics across the curriculum, Betty and colleagues introduced team-based learning into the workshop portion of 3 of the 6 courses in a pathophysiology and therapeutics course sequence.⁴¹ Team readiness assessment scores were approximately 20% higher than those for individuals, indicating the benefit of peer-teaching following the individual tests. Student satisfaction with team-based learning was also evident. The authors report that more than 90% of students felt that working in teams improved their understanding of course material and nearly the same percent attributed working in teams to improving their knowledge of disease treatment. Of the responding students, 83% were in support of team-based learning continuing in the course sequence.

Students did note, however, that the 3-hours spent in workshops was a long time to spend in a team-based learning session that did not represent a significant portion of their course grade.⁴¹ Furthermore, some students were frustrated with the faculty members, who answered questions with questions. This Socratic approach is an excellent way to facilitate discussion and build stronger critical thinking skills, but may be unnerving for some students.

Conway and colleagues integrated team-based learning into a cardiovascular module for second-year pharmacy

students.⁴² Although the use of team-based learning was limited to about 14% of the course, student performance was positively impacted. During the 2 years over which team-based learning was used, no students earned grades of D or F in the course as compared with 1.7% to 2.7% of students in the 2 years before the implementation of team-based learning.

Although the authors reported increased overall student and faculty satisfaction with team-based learning, a couple of concerns were raised. The faculty members reported that because of the complexity of the subject matter, it was unlikely that students would be able to learn all of the course content through independent reading. While this is certainly understandable, the intent of team-based learning is not for students to learn all course material independently, but to have faculty members facilitate the learning through careful selection of preclass materials for independent study followed by application of the knowledge in the classroom setting with their teams. The authors acknowledge that one of the barriers to the success of integrating team-based learning was students' initial resistance to self-directed learning as they were transitioning from passive attendance at lectures to being accountable for their own learning when they entered the classroom. This concern is commonly voiced by students who encounter team-based learning for the first time.^{9,11,43}

Team-based learning was added to 2 ambulatory care elective courses resulting in significantly higher student grades.⁴⁴ Zingone and colleagues reported that in addition to improved academic performance, student course evaluations were favorable. The authors suggested that the favorable response by the students was related to the instructors' use of learning objectives for the required reading and the consistent structure of the team-based learning sessions. Interestingly, once team-based learning was implemented, 88% of faculty members perceived the time required preparing for the course, conducting the sessions, and accessing student learning was less than for other small-group learning methods.

Grady described replacing a traditional lecture and workshop approach for teaching a pharmacotherapeutics module to third-year pharmacy students.⁴⁵ Although students were accountable for preparation before class and reportedly more active during the team-based learning sessions, there was no significant change in the module examination grades from the time immediately prior to the introduction of team-based learning as compared with the students who completed the module using team-based learning. Components of team-based learning, such as preassigned reading followed by a quiz at the start of class, were being used successfully in other courses in

the college of pharmacy. This suggests that it may be effective to introduce elements of team-based learning to engage students earlier in the learning process and to ensure they arrive in subsequent/future classes prepared to participate.

Two challenges were also noted by Grady. One was that teams had difficulty staying on task during the team-based learning session. Faculty members attempted to help teams refocus by enlisting the assistance of fourth-year pharmacy students to facilitate discussion in the classroom and selecting those teams who were no longer discussing the appropriate case to present their rationale to the class.

The other challenge was that students were frustrated by the lack of a single correct answer. This challenge is certainly well appreciated in pharmacy education and is not unique to any particular method of teaching. Students enter a PharmD program after taking dozens of course where receiving content through lectures is the norm. As a result, students often are accustomed to learning facts and being tested by seeking a single correct answer. Students thus have little exposure to discriminating between multiple correct answers to sort out the best of the correct answers. Pharmacy programs as well as others in health-care education attempt to teach students to think critically and have more confidence in decision making when faced with selecting the best of several correct answers on a test, simulation, or at a practice setting. This growth in learning is often challenging for students.

Persky recently reported the impact of converting a complete course in pharmacokinetics from a small group (“up to 50 students per group”) format to team-based learning.⁴⁶ Examination scores were significantly higher among students who were taught using team-based learning. Using Bloom’s Taxonomy, the author divided the levels of learning in the course (as determined by examination scores) into application and analysis (level 1) and creation and evaluation (level 2).⁷ The knowledge and comprehension levels of learning were assessed by quizzes. Such a division allowed for a more accurate assessment of learning at higher levels from significant assessment instruments like midterm and final examinations, in which instructors are often seeking greater exhibition of student understanding. Persky reported that student learning at both levels was greater in those students who were instructed using team-based learning, indicating that student performance increased at the highest levels of learning.

In addition to improved examination scores, the students also reported increases in professionalism, with a particular emphasis on altruism, accountability, and honesty.³ Students’ attitudes toward the experience of

working in teams was positive, noting that teams worked well together and individual team members felt respected and were motivated to work collaboratively.

Findings from the published reports discussed here of the success of team-based learning in the medical, nursing, and pharmacy curricula suggest that team-based learning can successfully be implemented as a small component of a course, for an entire content module, or as the teaching methodology for an entire course.

BENEFITS AND CHALLENGES

Learning in a team-based learning environment provides significant benefits to students. When learning in teams, students are engaged on task and actively connecting with the content being discussed. Students have the luxury of exploring different paths of reasoning and sharing their thoughts with team members in order to develop a sound justification for answering a posed question. This peer-level teaching and learning can have a powerful impact on student performance as it supplements the instructor’s perspective by introducing new avenues of inquiry.⁹

As many reports in the literature have outlined, content comprehension increases following team-based learning instruction as compared with passive lectures or small group learning. The increase in academic effectiveness can be attributed to the need for the students to be ready to apply the fundamental concepts in a course when they come to class. This readiness combined with the timely application of concepts to significant problems or case studies leads to a greater understanding of the course material as evidenced by improved course examination scores and performance on national board examinations. Team-based learning also affords the student the ability to self-access readiness and content understanding with the iRAT, a relatively low-stakes, individual assessment.

The nature of team-based learning is to have students work in teams and communicate to solve problems; thus, students who learn through team-based learning have improved interpersonal communication skills and attitudes about team building. The ability to communicate and work in a team-oriented environment are critically important to physicians, nurses, and pharmacists and often stated as skills that need improvement by the time students graduate and enter the workplace. Rather than waiting for these skills to develop *in situ* during clerkships or other practice experiences, team-based learning engages students in peer communication and team building in the classroom. Careful guidance from the instructor can also assist those teams that may not be functioning as highly as desired to improve communication and engage all team members in respectful conversation.

A significant benefit of using team-based learning in the classroom is the positive effect on attendance. Students are held accountable for preclass learning by the assessments, iRATs and tRATs, and for their team performance on the application exercises. In other words, during almost every class, students are graded. This provides a significant motivation to attend and participate in class.⁹ In fact, when no iRAT and tRAT are given at the start of class, attendance may drop somewhat. As groups of students develop into cohesive, high-functioning teams, there is a greater sense of accountability to the team which further encourages attendance.

Despite the reports of significant gains in student examination scores and improvements in communication and team building, team-based learning is not without challenges. Students who have spent a great part of their academic education in passive mode find a switch to team-based learning somewhat jarring. Many students have become relatively efficient at the art of bulimic learning where content is consumed and stored until the assessment of interest is completed, at which time the content is purged in order to prepare for the next academic gorging. This cycle of “cram then exam” is repeated again and again by students in an effort to keep abreast of the ever-increasing content students need to learn to prepare to practice at the highest level of their profession. Team-based learning helps break that cycle by mandating students learn basic content in advance and attend class to apply their knowledge and master the content in the process. It is this change in the familiar order of learning that is a difficult adjustment for many students.

Because team-based learning has both individual and team grading components, some students voice concern that they are not comfortable relying on others for a significant portion of their course grade, particularly if they have difficulty integrating into their team. It is often through the strength of their individual achievement that they gained admission into their degree program. Thus, some students may be used to competitive learning, whereas collaborative learning throughout a class or an entire curriculum is something novel. Prior bad experiences with team projects are often given as a reason for being leery of team-based learning. Fortunately, in a team-based learning environment, as students work together over weeks with a shared interest in success, most groups of students organize into efficient teams as individual members develop trust in each other. These high-performing teams outperform any individual member, leading to the ability to translate skill, knowledge, and value into practice.

Challenges for faculty members in adjusting to a team-based learning format generally surround the change in their role in the classroom. Similar to students, faculty

members are accustomed to lectures. Many instructors have spent years, if not decades, refining their skills at delivering content and becoming efficient at including as much information as possible into the lecture period. Team-based learning moves the faculty member from the “sage on the stage” to the “guide on the side” and places the student at the center of the academic inquiry. This change in role can be quite startling for seasoned faculty members who are used to stringent control of students’ attention. Such a change can lead some instructors to perceive a loss of purpose as they are not leading student learning from the front of the classroom. Although the instructors may not be controlling learning in the classroom, they are leading the process and guiding students to discover which information is important and how to solve problems. In other words, the instructors are guiding the development of the students’ critical-thinking skills in the classroom.

A concern of faculty members is that in an already busy curricular calendar, shifting time for teams to work on problems in class does not allow enough time for them to teach everything about a topic to the students. This may indeed be true. However, delivering lectures that cover everything on a topic does not ensure that students will learn what the instructor intended; in fact, content heavy lectures may actually lead to decreased student learning.⁴⁷

A pragmatic challenge for instructors is the reconstruction of their course material. While not much of a concern for faculty members new to academics, those who have spent years crafting excellent, informative lectures must now rethink and recreate materials for the classroom. Although faculty members have successfully transitioned their slide sets to team-based learning preparatory materials for the class, there is the need for readiness assurance tests and application exercises that can engage students in a team-learning environment.

RESOURCES

In addition to the primary literature, many other resources are available to instructors wishing to learn more about developing and implementing team-based learning in their educational setting. Three noteworthy books have been written about the development and implementation of team-based learning in post-secondary education.^{9,11,43} The first of these by Michaelsen and colleagues describes the fundamentals of team-based learning and how it can be used to teach various topics to college students.⁹ This work was followed up with a similar book dedicated to health professions education.¹¹ Another book focuses on implementing team-based learning in the social sciences and humanities.⁴³

A community of team-based learning educators can be found at the Team-Based Learning Collaborative

(www.teambasedlearning.org). The Web site offers information on getting started with team-based learning, available workshops and conferences, and examples of application exercises. The organization also has a listserv where subscribers can communicate directly with other instructors using team-based learning. Each year the Team-Based Learning Collaborative holds a conference where the latest research in team-based learning methods is presented and discussed. Experienced instructors also visit colleges and schools to hold workshops on implementing and advancing team-based learning.

SUMMARY

Faculty members continue to seek ways to engage students in the classroom to improve critical thinking, problem-solving skills, and knowledge retention. One of the missions of pharmacy education is to develop and foster lifelong learning skills because professional education does not end with graduation. Increasingly, skills in communication and teamwork are valued in the workplace. Active-learning strategies that develop communication and teamwork in addition to knowledge application are necessary for a student's success as a practitioner. One such method, team-based learning, is on the forefront of instructional strategies that develop students as collaborative learners in the classroom in preparation for becoming a member of a healthcare team. The use of team-based learning improves student engagement, communication, team-building, and knowledge retention. Although learning in the team-based learning classroom is quite different from listening to passive lectures, students and faculty members can acclimate quickly and step into their new roles quite well if given the appropriate time and support.

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