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RESEARCH

Student Perceptions of Team-based Learning vs Traditional Lecture-based Learning

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Objective. To evaluate pharmacy student perceptions of team-based learning (TBL) vs traditional lecture-based learning formats.

Methods. First professional year pharmacy students (N=111) at two universities used TBL in different courses during different semesters (fall vs spring). Students completed a 22-item team perceptions instrument before and after the fall semester. A 14-item teaching style preference instrument was completed at the end of the spring semester. Data were analyzed using Wilcoxon signed rank test and Mann-Whitney U test.

Results. Students who experienced TBL in the fall and went back to traditional format in the spring reported improved perceptions of teams and preferred TBL format over a traditional format more than students who experienced a traditional format followed by TBL. Students at both universities agreed that the TBL format assists with critical-thinking, problem-solving, and examination preparation. Students also agreed that teams should consist of individuals with different personalities and learning styles.

Conclusion. When building teams, faculty members should consider ways to diversify teams by considering different views, perspectives, and strengths. Offering TBL early in the curriculum prior to traditional lecture-based formats is better received by students, as evidenced by anecdotal reports from students possibly because it allows students time to realize the benefits and assist them in building teamwork-related skills.

Keywords: team-based learning, lecture-based learning, pharmacy students, student perceptions

INTRODUCTION

Team-based learning (TBL) is increasingly used in higher education because it employs active learning to promote self-directed learning (deep learning) and enhances student adaptability in problem-solving situations.[1,2] Deep learning results in greater retention of the material, likely because students understand and make personal sense of the material, rather than simply memorize and reproduce it.[3] Deep learning is an essential skill for health care professionals as they must retain knowledge and understand and incorporate new evidence as it becomes available. Team-based learning is a useful tool for developing deep-learning skills in a variety of disciplines and educational settings.[4] As a teaching strategy, TBL yields similar results as lecture-based formats on evaluations of short-term learning of application skills.[5]

Team-based learning is beneficial to both course facilitators and students. It improves student performance in both academically weak and academically strong students.[6-8] When TBL is employed, students perform better on examination questions, indicating their increased mastery of course content.[9-11] Using TBL may help students achieve the same or better knowledge scores than using more traditional methods;[12] it also may provide a small-group experience in a large class without needing a large number of faculty members.[13,14] Through use of TBL, faculty members can shift factual content delivery to pre-class preparation, leaving more class time for active learning and integration of new learning with the knowledge gained before class.[15] Faculty members perceive TBL may impact student behaviors, such as being better prepared for class, being more engaged during class, and taking more responsibility for their own learning.[16]

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Team-based learning also provides greater student-to-instructor engagement than traditional lecture during the learning process.[17]

Michealson et al describes TBL as beginning with guided student readings and assignments completed prior to class.[9,15] Upon arrival in class, students take an individual readiness assessment test (iRAT), which consists of approximately 10 multiple-choice questions covering the preclass work and targets the remembering and understanding levels of Bloom's Taxonomy.[18] After completion of the iRAT, the same quiz is taken by the TBL groups as a team readiness assurance test (tRAT). Discussion or a "mini-lecture" follows, during which muddy points identified by the readiness assessment process can be explained, and more complex issues can also be addressed. Next, TBL groups work on an application exercise, which requires the use of critical-thinking skills to apply the information learned to a complex problem or case scenario. The learning session concludes with discussion and wrap up.

Student perceptions of TBL are often positive as it provides students with a high degree of satisfaction and an engaging environment. [6,19,20] Pharmacy students indicate that TBL improves their professional competencies and abilities, as well as their ability to communicate and think critically.[16] Faculty members believe that, compared to other teaching strategies, TBL can enhance student engagement, preparation, and achievement of course outcomes.[16,18] However, little research compares student preference for TBL vs traditional, lecture-based learning.

Incorporation of TBL into pharmacy education is limited, despite the fact that it fulfills an Accreditation Council for Pharmacy Education (ACPE) guideline under Standard 11, which encourages curricular incorporation of active-learning strategies to develop critical-thinking and problem-solving skills.[21] When incorporated, TBL is successful in pharmacy curricula because it provides a high level of student satisfaction.[4,10,18,22-24] It may also be more effective than traditional lectures at engaging students across all domains of Bloom's Taxonomy.[18] Typically, TBL is integrated into a course module unit. Less common is integration into an entire course. Therefore, the objective of this study was to evaluate pharmacy student perceptions of TBL by comparing a semester-long TBL course to a similar course that used lecture-based teaching.

METHODS

This cross-sectional study was conducted at two universities. Institutional Review Board exempt status was obtained at each university prior to conducting the study. Participants were first-year professional pharmacy students at Cedarville University School of Pharmacy and at Manchester University College of Pharmacy. Both universities are developing new pharmacy programs and implementing active-learning curricula as recommended by ACPE standards. Cedarville University is a small (3400 students), private, primarily liberal arts institution located in southwestern Ohio. It has multiple graduate programs including the professional pharmacy program. Manchester University is also a small (1400 students), private, primarily liberal arts institution located in northeast Indiana. It also has multiple graduate programs including the professional pharmacy program. Cedarville's maximum pharmacy class size is 65 students, while Manchester's is 73.

Student teams at Cedarville University consisted of 5-6 students, and each group contained at least 2 males, which allowed for a stratified distribution of gender among teams. Students were also assigned to teams based on personality type. Prior to entering their first professional year of pharmacy school, students completed the Myers-Briggs "M form" to determine their individual Type Indicator (MBTI). Taking into account results of this assessment, groups were formed that included a variety of introverted and extroverted students as heterogeneous teams are more successful than homogeneous teams.[25-27] For example, a team with extroverted and introverted members sees benefits in the team's attitude.[28] By organizing groups based on these personality traits, differing perspectives and work methods were accounted for in each student group.

Cedarville used student teams in two P1 (first professional year) semester-long TBL courses: Biochemistry (4-credit hours) and Self-Care (2-credit hours). Students were engaged in weekly TBL (iRATs, tRATs, and application exercises) for each core concept of the courses. Students also completed 2 peer evaluations to promote accountability. Students then returned to traditional, lecture-based courses during the spring semester. At the time of this study, Cedarville students did not take any courses in the spring semester that utilized TBL pedagogy; therefore, students did not work in their teams.

Originally, teams at Manchester University were intended to be formed based on learning styles, as students with different learning styles perform better together.[26,29] Learning styles were assessed by the Health Professionals' Inventory of Learning Styles (H-PILS), but more than two-thirds (68%) of students turned out to be assimilators. Thus, there was insufficient diversity in learning styles to arrange teams accordingly. Student teams consisted of 5-6 students and contained at least 2 males to allow for gender diversification. Minority ethnicities were paired so no group had only one person of a minority ethnicity. Thus, students were placed into teams based primarily on gender and ethnicity diversification. Learning styles became a secondary determinant. Manchester

used a traditional lecture format in their fall Biochemistry course; TBL was implemented in the Self-Care course during the P1 year, spring semester. Students engaged in weekly TBL (iRATs, tRATs, and application exercises) for each core concept in a similar format as the one used at Cedarville. Students also completed peer evaluations to promote accountability.

A demographic instrument (10 items) was administered to all students at the beginning of the fall semester, which consisted of questions about gender, ethnicity, age, cumulative GPA, and previous work experience in a pharmacy. Three additional items asked how frequently students studied in groups, completed reading assignments before attending class (5-point Likert-type scale, always to never), and level of agreement with wanting to work alone vs in a group (7 point Likert-type scale, strongly agree to strongly disagree).

Students also completed a survey on their perceptions of TBL, which was developed from a review of the literature and underwent student review (one student), peer review (faculty members at both institutions), and expert review (a TBL expert, an assessment expert, and an instructional design expert). The instrument assessed student perception of teams as well as their beliefs and values in teamwork with items such as "Each team member should have an equal voice" and "A team should have shared beliefs about how to achieve success" (22 items, 7-point Likert-type scale, strongly agree to strongly disagree) at the beginning and end of the fall semester and results from Cedarville (TBL Biochemistry and Self-Care during fall semester) and Manchester (nonTBL-based courses during fall semester) were compared. Results within universities were also compared.

Finally, students completed an instrument to assess their perceptions of TBL vs traditional lecture (14 items, 7-point Likert-type scale, strongly agree to strongly disagree). The instrument was developed from a review of the literature, which entailed compiling and adapting publicly available questions pertaining to student preference for TBL.[7,22,30,31] This survey underwent the same student, peer, and expert review as outlined above. This instrument was administered to students at both universities at the end of the spring semester after Cedarville returned to a semester of lecture-based teaching and Manchester had completed their TBL course. The timeline for the assessments is presented in Figure 1.

All data was entered into Microsoft Excel, and analyses were performed utilizing SPSS v21.0 (IBM, Armonk, NY). An a priori level of $\alpha = 0.05$ was used to determine statistical significance. Demographic data was analyzed using descriptive statistics. Because the demographic data did not pass the test for normality and because they were nominal data, Chi-square tests were run on them to look for significant differences between the universities. Nonparametric tests were used because the data was Likert-type and not normally distributed. Pre/post changes on the TBL perceptions survey were evaluated using Wilcoxon signed rank test, and differences between the two universities were evaluated using the Mann-Whitney U test. Differences between the universities on the TBL vs traditional lecture survey were also evaluated using the Mann-Whitney U test. Comparisons were made on the 7 themes (thinking critically, problem solving, being more prepared for examinations and quizzes, keeping up-to-date with the material, and pedagogy preference) between TBL and traditional lecture using the Wilcoxon signed rank test.

RESULTS

One hundred eleven students (Cedarville: n=53, 100% response rate; Manchester: n=58, 92.1% response

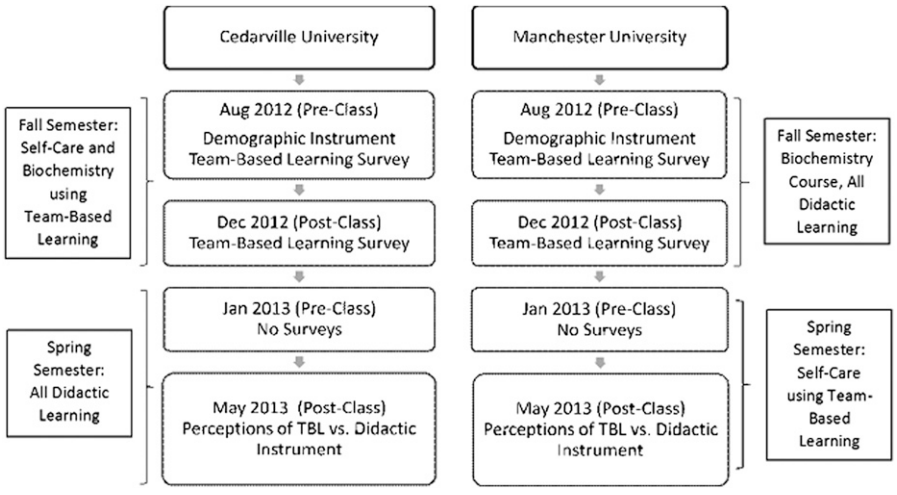

Figure 1. Timing of Survey Administration by University Comparing Team-based Learning vs Didactic Learning

rate) completed the survey. There was no significant difference in gender composition of the classes between institutions ($p=0.68$). However, there were significant differences between the institutions with respect to ethnicity ($p<0.001$), age ($p<0.001$), and previous degrees held ($p=0.029$), with Manchester having a more ethnically diverse class, an older class, and more students with previous degrees. The GPA at matriculation into the professional program was significantly higher for Cedarville students than for Manchester students ($p=0.001$). At baseline assessment, 86% (n=101) of the participants stated that they frequently or always completed assigned readings before attending class (Table 1).

After a semester with 2 courses using TBL (Figure 1), students at Cedarville significantly changed their perceptions of teams for 6 statements (Table 2). Student responses indicated a significant increase in agreement on 5 statements: team meetings can produce excellent outcomes; input from all team members should be used whenever possible; team members should feel free to provide honest opinions; teams should consist of individuals with different personality types; and teams should consist of individuals with different learning styles. However, students significantly disagreed regarding the statement that team members' roles should be clearly defined and accepted by all team members. Responses to the TBL vs traditional lecture survey were significant, with increased agreement that TBL was more effective than traditional lecture in relation to the 7 themes ($p<0.001$) (Table 4, thinking critically, problem solving, being more prepared for examinations, being more prepared for quizzes, keeping up-to-date with the material, and pedagogy preference).

After a semester with only lecture-based learning at Manchester (Figure 1), significant pre/post declines were observed for 6 statements (Table 2): team members should fulfill their commitments to the goals of the team; team members should see participation as a responsibility of professionalism; there should be a feeling of openness and trust in a team; every team member should participate fully in team meetings; team members should not allow personal priorities/agendas to hinder team effectiveness; and team members should feel free to provide honest opinions. Two statements had significant increases: teams should consist of individuals with different personality types and teams should consist of individuals with different learning styles. At the conclusion of the year (one TBL course in the spring semester), the Manchester students had more agreement with the TBL-based statements but only one response was significant: TBL helps me to problem solve ($p=0.041$).

There were significant differences between Manchester and Cedarville for two statements on the posttest (Table 2). Cedarville students responded with a higher level of agreement than Manchester students that team members should fulfill their commitments to the goals of the team and that team members should see participation as a responsibility of professionalism. Despite clear differences between the perceptions of Cedarville and Manchester students in response to many of the questions, significantly more students at both universities agreed in the posttest that teams should consist of individuals with different personality types and learning styles (Table 2).

DISCUSSION

This study was initiated to assess preperception and postperception of TBL in two courses and to assess the perception of TBL vs lecture-based learning in the first professional year at two universities. Although the scheduled timing of TBL vs lecture-based pedagogy and other factors differed at the universities, this study does provide informative feedback with regard to student perceptions of the pedagogies.

Team-based learning requires a shift in the paradigm for learning. Student accountability increases significantly because students must work independently to prepare for team sessions, in which they will work to solve problems with their teammates.[32,33] Instructor-directed preclass learning may consist of textbook readings, articles from primary literature, and/or instructor-prepared materials.[15] Students are held accountable for this material in the readiness assurance portion of the TBL session and then expected to apply that knowledge to an application session, which may involve a more complex biochemical problem or a patient case.[15] Students often resist implementation because TBL or any type of active learning is a shift from the passive process of lecture-based settings.[15,23,33,34] Anecdotally, when the Cedarville students learned that the second semester was going to use traditional lecture format, they were vocal about desiring the continuation of TBL. Similarly, Letassy et al found that when students entered courses following a TBL module, they were frustrated by the lack of self-directed, active learning and requested that the course adopt TBL methods.[32]

Cedarville students indicated a preference for TBL on the TBL vs traditional lecture survey. When the responses of the Cedarville students to the 7 basic themes were analyzed, students were significantly more likely to agree with the TBL-based statements vs the traditional format. The Manchester students responded in a similar direction but only one response was significant (TBL helps me to problem solve). This may be the case because the Cedarville students were exposed to TBL in their first semester of their first professional year rather than initially being exposed to traditional lecture-based instruction followed by TBL.

Table 1. Comparison by University of Student Demographics

	Cedarville (n=53) n (%)	Manchester (n=64) n (%)	Pearson Chi-square value	*p* value
Gender			0.17	0.68
Male	22 (41.5)	29 (45.3)		
Female	31 (58.5)	35 (54.7)		
Ethnicity			20.43	0.00
Caucasian	45 (84.9)	29 (45.3)		
African American	3 (5.7)	7 (10.9)		
Hispanic	0 (0.0)	2 (3.1)		
Asian or Pacific Islander	3 (5.7)	16 (25.0)		
Other	2 (3.8)	10 (15.6)		
Age			26.04	0.00
Less than 19	0 (0.0)	1 (1.6)		
20	1 (1.9)	3 (4.7)		
21	27 (50.9)	7 (10.9)		
22	10 (18.9)	14 (21.9)		
23	2 (3.8)	9 (14.1)		
24	1 (1.9)	7 (10.9)		
Older than 24	12 (22.6)	23 (35.9)		
GPA			20.55	0.001
3.75 to 4.00	8 (15.1)	4 (6.3)		
3.50 to 3.74	14 (26.4)	10 (15.6)		
3.25 to 3.49	18 (34.0)	18 (28.1)		
3.00 to 3.24	12 (22.6)	10 (15.6)		
2.75 to 2.99	1 (1.9)	17 (26.6)		
2.50 to 3.74	0 (0.0)	5 (7.8)		
Previous Degrees			8.99	0.029
Bachelors of Science	10 (16)	36 (57.6)		
Bachelors of Arts	7 (11.2)	6 (9.6)		
Masters of Science	1 (1.6)	1 (1.6)		
Other	1 (1.6)	13 (20.8)		
How likely are you to complete assigned readings before coming to class?			5.85	0.21
Always	11 (20.8)	18 (28.1)		
Frequently	37 (69.8)	35 (54.7)		
Occasionally	5 (9.4)	6 (9.4)		
Rarely	0 (0.0)	4 (6.3)		
Never	0 (0.0)	1 (1.6)		
I prefer to work on projects individually.			15.00	0.02
Strongly Agree	11 (20.8)	4 (6.3)		
Agree	16 (30.2)	8 (12.5)		
Somewhat Agree	12 (22.6)	23 (35.9)		
Neutral	6 (11.3)	16 (25.0)		
Somewhat Disagree	6 (11.3)	8 (12.5)		
Disagree	2 (3.8)	4 (6.3)		
Strongly Disagree	0 (0.0)	1 (1.6)		
How frequently do you study in groups?			2.92	0.71
Always	1 (1.9)	2 (3.1)		
Frequently	15 (28.3)	21 (32.8)		
Occasionally	23 (43.4)	30 (46.9)		
Rarely	12 (22.6)	8 (12.5)		
Never	2 (3.8)	3 (4.7)		

Table 2. Comparison by University of Perceptions of Team-based Learning

	Cedarville University (n=53)						Manchester University (n=57)						
Question	Median Pre	Median Post	Negative Difference	Positive Difference	No Change	*p* Pre-Post	Median Pre	Median Post	Negative Difference	Positive Difference	No Change	*p* Pre-Post	CU-MU Post *p*
Each team member should have an equal voice.	6	6	8	13	32	0.28	7	6	16	7	34	0.17	0.31
Team members should make team meetings a priority.	7	6	12	11	30	0.84	6	6	16	8	33	0.24	0.13
Team members should be able to depend on one another.	7	7	11	12	30	0.87	7	7	12	7	38	0.49	0.16
Team members should fulfill their commitments to the goals of the team.	7	7	6	7	40	0.78	7	7	17	5	35	0.009	0.012
Team members should see participation as a responsibility of professionalism.	7	7	7	13	33	0.14	7	7	19	6	32	0.012	0.027
Team meetings can produce excellent outcomes.	6	6	7	19	27	0.01	6	6	16	10	31	0.075	0.67
There should be a feeling of openness and trust in a team.	6	7	7	11	35	0.28	7	7	14	4	39	0.009	0.48
A team should have shared beliefs about how to achieve success.	6	6	12	18	23	0.17	6	6	15	15	27	0.87	0.28
Each team member should demonstrate a sense of shared responsibility for the success of the team.	7	7	8	8	37	1.00	7	6	14	10	33	0.303	0.39
Input from all team members should be used whenever possible.	6	6	9	22	22	0.007	6	6	17	8	32	0.181	0.054
Every team member should participate fully in team meetings.	6	6	6	11	36	0.23	7	6	21	5	30	0.010	0.19

(*Continued*)

Table 2. (*Continued*)

Question	Cedarville University (n=53)						Manchester University (n=57)						CU-MU
	Median Pre	Median Post	Negative Difference	Positive Difference	No Change	*p* Pre-Post	Median Pre	Median Post	Negative Difference	Positive Difference	No Change	*p* Pre-Post	Post *p*
Team members should not allow personal priorities/agendas to hinder team effectiveness.	6	6	16	13	24	0.29	6	6	22	8	27	0.004	0.13
Team member roles should be clearly defined and accepted by all team members.	6	6	21	3	29	0.003	6	6	16	16	25	0.85	0.30
Team members should keep each other well informed.	7	6	14	6	33	0.061	7	7	15	5	37	0.052	0.43
In team meetings, team members should stay on track and on time.	6	6	12	8	33	0.61	6	6	13	12	31	0.58	0.63
Team members should feel free to provide honest opinions.	6	7	6	13	33	0.044	7	7	14	3	40	0.007	0.26
Team members should take initiative to put forth ideas and concerns.	6	6	8	13	32	0.18	7	6	14	6	37	0.22	0.60
Team members should respect one another.	7	7	9	6	38	0.44	7	7	10	4	43	0.23	0.20
All team members should be involved when making decisions.	6	6	10	14	29	0.41	7	6	13	3	41	0.067	0.90
Each team member should pull his or her weight.	7	7	10	7	36	0.52	7	7	12	6	38	0.30	0.063
Teams should consist of individuals with different personality types.	5	6	7	26	20	0.00	5	6	8	23	26	0.006	0.36
Teams should consist of individuals with different learning styles.	5	6	10	26	17	0.001	5	6	8	28	21	0.004	0.85

Scale: 1=strongly disagree…7=strongly agree

Table 3. Comparison by University of Responses to the Team-based Learning (TBL) vs Traditional Lecture Survey

Statement	Median Response		Z	*p*
	Cedarville	Manchester		
TBL format helps me think critically.	6.5	6	-3.36	0.001
TBL format helps me problem solve.	6.5	6	-3.07	0.002
Traditional lecture format helps me think critically.	5	5	-3.13	0.002
Traditional lecture format helps me problem solve.	4	5	-3.23	0.001
I feel more prepared for examinations with TBL format.	6	5	-2.94	0.003
I feel more prepared for quizzes with TBL format.	6	5	-3.20	0.001
I feel more prepared for examinations with the traditional format.	4	4.5	-3.13	0.002
I feel more prepared for quizzes with the traditional format.	3	4	-4.60	0.00
TBL format keeps me up-to-date with respect to information being presented in class.	7	5	-5.45	0.00
Traditional lecture format keeps me up-to-date with respect to information being presented in class.	3	5	-5.13	0.00
For me, the TBL format provides excellent outcomes.	6	5	-2.59	0.01
For me, a traditional lecture format provides excellent outcomes.	4	5	-3.49	0.00
I prefer a traditional lecture format over a TBL format.	3	4.5	-3.34	0.001
I prefer a TBL format over a traditional lecture format.	6	5	-3.03	0.002

Scale: 1=strongly disagree. . .7=strongly agree

Responses from students at Cedarville differed from those of Manchester students in their level of agreement on all the TBL vs traditional lecture items. Cedarville students viewed TBL more positively. This could be a result of the time frame of TBL implementation at the two universities. Moreover, if the initial semester can be seen to set the stage for future semesters, then students will likely become comfortable with the format chosen for their first-semester courses. The Cedarville students began the first semester of their professional program with TBL, whereas the Manchester students experienced traditional lecture format in their first semester. Cedarville also had two courses with TBL, perhaps giving them the impression that the school was committed to its use. At Manchester, a single course in the spring semester might be seen as an aberration, with little perceived dedication from the college to this style of learning, resulting in resistance from students to something not necessarily institutionally supported or valued.

Students from Cedarville demonstrated significant positive changes in perception with respect to two statements that deal with the workings of a team in any setting, but particularly in a TBL course. Students recognized (ie, increased their level of agreement) over the course of the semester that input from all members is valuable during the team meetings and that team members should feel free to provide honest opinions. This is important as teams function best when all members participate.[35] Conversely, Cedarville students had a significant negative change in perception regarding the statement that team member roles should be clearly defined and accepted by others. This may be a result of Cedarville students working through the stages of group dynamics (outlined by Tuckman and reviewed more recently by Bonebright[36,37])

Table 4. Comparison by University of Responses to the Team-based Learning (TBL) vs Traditional Lecture Survey

Statement	Cedarville				Manchester			
	TBL Median	Lecture Median	Z	*p*	TBL Median	Lecture Median	Z	*p*
. . . helps me think critically.	6.5	5	4.74	<0.001	6	5	1.38	0.17
. . . helps me problem solve.	6.5	4	4.80	<0.001	6	5	2.04	0.041
I feel more prepared for examinations with. . .	6	4	4.05	<0.001	5	4.5	0.86	0.39
I feel more prepared for quizzes with. . .	6	3	5.11	<0.001	5	4	1.03	0.31
. . . keeps me up-to-date with respect to information being presented in class.	7	3	6.01	<0.001	5	5	1.67	0.096
For me, . . . provides excellent outcomes.	6	4	4.47	<0.001	5	5	0.59	0.56
I prefer . . .	6	3	3.60	<0.001	4.5	5	0.20	0.84

Scale: 1=strongly disagree. . .7=strongly agree

in 2 classes and arriving at a phase where each student functioned as needed to make the team successful. In other words, the student roles became flexible to support the task performance.

However, students at Manchester did not value the components of team work as evidenced by the decrease in agreement with the statements that team members should fulfill their commitments to the goals of the team, team members should see participation as a responsibility of professionalism, there should be a feeling of openness and trust in a team, every team member should participate fully in team meetings, team members should not allow personal priorities/agendas to hinder team effectiveness, and team members should feel free to provide honest opinions. Again, the timing of the introduction of TBL at the two institutions may have played a role in the positive changes in perception by the Cedarville students vs the negative changes in perception by the Manchester students.

On the other hand, both Cedarville and Manchester students demonstrated a significant positive change in the level of agreement that groups should consist of individuals with different personality types and different learning styles, which indicates that students believe heterogeneity of TBL groups contributes to better-functioning groups. Experts concur that TBL groups function best when groups are heterogeneous.[33] However, there is no consensus in the literature as to what the basis of that heterogeneity should be, except that the higher the number of females in the group, the higher the collective intelligence of the group.[38] Literature in the business field may suggest personality diversity plays a key role in team success,[39] but this has not been studied in the health professions context. The heterogeneity in the Cedarville groups was based upon MBTI results alongside considerations of gender.

Learning styles also have the potential to impact learning that takes place in a small-group TBL setting. Again, this has not been explored extensively in the health professions education. Novak and colleagues examined learning styles of second-year pharmacy students before and after a problem-based teaching experience, finding that students' learning styles altered as a result of the experience.[40] Pugente et al examined the relationship between student learning styles and their preferences toward activities in a problem-based approach, finding convergers had the highest preference for the activities.[41] However, neither research team examined the impact of individual learning styles on group functioning. Our methods and the survey findings indicate learning styles, as well as other mechanisms, such as gender, ethnicity, and personality types, can be used to successfully diversify groups.

Even though the team-based learning survey was found to have a good internal consistency (Cronbach's $\alpha = 0.90$), additional validation is needed for generalizability as this survey was used at only two institutions. Furthermore, the TBL vs traditional lecture survey did not have adequate internal consistency ($\alpha = 0.51$). Validation of the surveys in larger, more diverse groups is needed to further determine their reliability and validity.

There were several factors that could be confounders in our study, suggesting that differences were not just a result of the timing of TBL introduction. The use of different instructors, course content, examinations, and course expectations in the evaluated courses may have accounted for differences in perceptions of TBL and traditional lecture-based teaching. This limitation was minimized by the two institutions sharing course outcomes and objectives to minimize differences in material delivered. While teams at the universities had similar gender diversity, Cedarville also diversified teams by MBTI types. This difference could have impacted how students felt about working with their team and may have resulted in greater positive perceptions of TBL. Distributing teams in the same manner would be beneficial in future research. Additionally, Cedarville used TBL in 2 courses, while Manchester only used it in one course. This may have allowed Cedarville students more time to become familiar with TBL and thus have a more positive perception of it. Class composition at the schools may have also played a role in the differences in perception of TBL; Manchester had an older and more ethnically diverse class with more students holding previous degrees.

When working in teams, conflict is inevitable and can impact a student's perceptions of TBL. Going forward, more instruction and guidance in conflict resolution and the use of constructive feedback should be provided while adding team-building exercises at the outset of the semester to allow for consistency in dealing with team conflicts.

Problems encountered with TBL implementation include a lack of faculty "buy-in" or attitude toward the method.[42,43] Faculty members have to accept the risk of implementing something new and potentially challenging. Substantial faculty training in the TBL pedagogy is essential for any program.[43] Cedarville faculty members had the opportunity to observe TBL in action at Wright State University School of Medicine and attend multiple TBL seminars. Manchester faculty members had no formal TBL training, which could have led to differences in implementing and, in turn, differences in student perceptions of the method. Implementation of TBL in a single course or within only one or two sessions of a course can produce challenges. Students may have to prepare much

more for that session or course, since TBL requires pre-class preparation. In turn, this can lead to poorer student evaluations of faculty members and ultimately, reinstatement of previous "successful" teaching methods.[44]

CONCLUSION

When TBL was implemented in the first semester (at Cedarville University), students had more positive perceptions of teams and teamwork by the end of the semester than students who had traditional lecture-based learning (at Manchester University). Similarly, students who had two TBL courses first then went back to lecture-based learning preferred TBL, while students who had lecture-based instruction followed by a single TBL course preferred lecture. Thus, the timing of implementing TBL in the curriculum and quantity of courses implemented may impact student perceptions of its utility. Building team-based skills are important, given the increasing team-based, patient-centered health care approach in the United States health care system. Universities should consider adopting team-based activities earlier in the curriculum to allow students time to realize the benefits to their education. Also, students at both universities appreciated and preferred diversity in their teams, particularly related to learning styles and personality types. When building teams, faculty members should consider ways to bring different student views, perspectives, and strengths together.

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