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Short Communication

Using team-based learning in a large interprofessional health science education experience

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ABSTRACT

A longitudinal interprofessional experience consisting of three half-day sessions and involving more than 600 students from ten academic programs was facilitated at the University of Florida Health Science Center. During the curriculum design process, team-based learning (TBL) emerged as an andrologogical solution that could enable effective and efficient curricular adoption. Preliminary preparatory readings were made available online and knowledge of the readings was assessed using individual readiness assurance tests (IRAT), with follow-up testing of team knowledge using team readiness assurance tests (TRAT). Learners applied this knowledge using clinically based cases and discussion questions in each of three sessions: patient safety, professional ethics, and health systems and disparities. Student performance on knowledge assessments was typical for TBL activities, that is, TRAT scores were significantly higher than IRAT scores. There were few significant differences in performance by discipline. Student perceptions of teamwork competencies and participation were routinely excellent, with averages ranging from 4.86 to 4.90 out of a maximum of 5 on a Likert-type scale. Using TRAT performance as a comparative variable, there was a statistically significant association between performance on the TRAT and student evaluation of teamwork; specifically, among those who indicated that their team included one or more exceptional team members, the team performed higher on the assessment.

Introduction

Health professions education accreditation standards and health care delivery needs are prompting an increasing demand for interprofessional education (IPE).[1,2] Well-known constraints for IPE implementation, such as scheduling and academic calendar conflicts, and space, present challenges for large scale IPE implementation within academic programs.[3,4] Additionally, curriculum change to include interprofessional learning often requires additional educational resources, notably, faculty time and expertise. A further challenge during IPE implementation is the balance between specific learning content, such as cultural competency, quality improvement principles, ethical principles, etc. and acquisition of interprofessional collaborative competencies, such as the core competencies outlined by the Interprofessional Education Collaborative 2011 report.[5] Frequently institutions have adopted active learning methods when incorporating IPE into their curricula.[6]

Team-based learning (TBL) is an active learning method that uses relevant problems to prompt students to exchange knowledge and perspectives, in turn, building upon their current understanding, exposing inconsistencies and providing opportunity for new learning.[7] TBL has emerged as a popular teaching methodology in medical and health professions education.[7,8] TBL is a small group teaching approach that facilitates interactive, cooperative, and student-centric learning; being grounded in the assumption that student learning is enhanced by working in teams.[9] At the same time TBL's structured format promotes accountability and active participation.[10]

TBL follows a prescriptive format in which teams of students are first assessed using an individual readiness assurance test (IRAT), which addresses their own understanding of the pre-reading assignment. Students then immediately take the same assessment again as a team, the team readiness assurance test (TRAT), where they work collaboratively on the same items. During this team assessment learners use an Immediate Feedback Assessment

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Technique (IF-AT) "scratch-off" card to obtain feedback as to whether a response is correct or not. After the readiness assurance testing process is complete, the teams engage in application exercises. Application exercises consist of a significant problem, or problems, relevant to the learning content. Teams reason through the problem and publicly report their solutions, which prompts discussion amongst teams to further elucidate perspectives and thinking to promote additional student learning.[9] TBL is a proven and effective method of instruction for health professions students in "uni-professional" contexts.[10–12] Given its collaborative, constructivistic nature, TBL seems an ideal method to enhance students' application of team skills. Emerging research is exploring the team related dimensions of TBL, including the role of team cohesion, size and other factors.[13,14] However, there appears to be little examination of how specific team skills and dynamics, apart from cohesiveness, may influence students' experience with TBL and associated performance outcomes. The purposes of this study were to assess the effectiveness of interprofessional TBL for: 1) students' knowledge acquisition in specific content areas; 2) application of their teamwork skills; and 3) if particular teamwork skills used in TBL were associated with improved learning performance outcomes.

Instructional context

In 2010 the University of Florida Academic Health Science Center outlined a strategic plan that included an enhanced interprofessional focus. The institution has a historical commitment to IPE, but had not operationalized this commitment beyond the first year of students' health professions education.[15,16] A second year IPE experience, Interprofessional Learning in Healthcare (IPLH), was designed to build upon students' first year experience: Putting Families First (PFF). PFF is a longitudinal service learning experience focused on foundational knowledge, skills, and attitudes related to teamwork, interprofessional education, and fundamental issues related to public health.[15] IPLH needed to be designed to involve learners from ten separate degree programs (audiology, dental, medicine, nursing, occupational therapy, pharmacy, physician assistant studies, physical therapy, public health, speech-language pathology) across five colleges (dentistry, health and health professions, medicine, nursing, and pharmacy). A majority, but not all of these programs participate in PFF, because of this, IPLH needed to be inclusive and reflective of the budgetary limitations associated with the economic downturn begun in 2008. Due to limited funds and desire for active, team-based collaboration, TBL emerged as a viable teaching methodology.

Unlike other student-centric learning activities, such as problem-based learning, TBL does not require a faculty facilitator for each small group; a few faculty, when trained properly, can facilitate many small TBL groups simultaneously. Thus, TBL offers a small-group learning experience for students without the need for a large cadre of faculty facilitators.[17] The TBL approach allowed us to address institutional objectives around a common institutional curriculum in addition to core interprofessional competencies.[18–20] Furthermore, TBL allowed us to balance the logistical issues associated with faculty and facilities, particularly given the faculty and facility resource intensity of our first year experience (nearly 100 faculty facilitators and 50 meeting rooms or classroom spaces able to hold 18 individuals). With TBL, we would need a fraction of the faculty (16 facilitators) and classrooms (eight large ballrooms in the university student union).

IPLH consists of three separate, three-hour TBL sessions approximately seven weeks apart. An interprofessional group of faculty collaboratively designed content addressing contemporary issues in ambulatory patient safety, clinical ethics and health systems, all of which address components of a common curriculum within the institution.[18–20] Learners were assigned to teams of seven students, with at least five different programs represented on each team, for all three sessions. Assignment occurred in a semi-random manner, assuring professional diversity while ignoring prior teamwork experiences in PFF. The decision to ignore prior history during team assignment was purposeful to counter the development of factions or 'cliques'.[21] Multiple small groups were then assigned to rooms with between nine and twelve teams per room. At least two interprofessional faculty facilitators were assigned to each room. Approximately one month prior to each event students received email instructions with information on how to access pre-reading materials, their team number, and room location. On the day of the activity, using the standard TBL format, after an introduction to the session, students were assessed on the pre-readings as both individuals and teams using the IRATs and TRATs. After completion of the TRAT, student teams engaged in application exercises requiring them to reason through clinically oriented scenarios; teams were required to share their responses and facilitators engaged teams in discussion about possible and correct responses.

Methods

Prior to the collection of data, a study protocol was submitted and reviewed by the University of Florida IRB. It was determined to represent exempt research. Data was collected during the 2012–2013 academic year; 639, 626 and 631 students participated in the three sessions respectively. Varying levels of individual student participation were associated with prior authorized excused absences for conference attendance and sickness. Those individuals who were not in attendance completed an alternative assignment. To assess student knowledge acquisition, student responses for each session's IRAT were collected via paper based quizzes and graded by a faculty member in the institution's Office of Interprofessional Education. TRAT responses for each session were collected via IF-AT forms at the end of the TBL session. Each sessions IRAT and TRAT contained either seven (Sessions 1 and 3: Patient Safety and Health Systems) or eight (Session 2: Ethics) multiple choice items based upon the assigned pre-readings for the session.

To assess students' application of their team skills during the third and final IPLH session each student completed a paper-based Team Competencies Instrument evaluating teamwork behaviors demonstrated by the group. The Team Competencies Instrument was designed to assess application of basic teamwork skills in the areas of: 1) achieving the group tasks; 2) maintaining positive group communication; and 3) displaying a positive attitude, using a scale of 1 = never and 5 = consistently. Additionally, students were asked: a) if one or more individuals on the team did not 'pull their weight'; b) if everyone on the team contributed approximately equally; and c) if one person on the team was an exceptional contributor to the team's efforts, using a scale of 1 = strongly disagree; 5 = strongly agree. Students were instructed to complete the form anonymously, but there was a team identifier so that results could be collected and analyzed in aggregate for the team. The instrument was originally developed by colleagues at the Medical University of South Carolina, for self-assessment of team skills.[4,22] It was designed based upon a review of the teamwork literature and consideration of skills relevant to learners in a health-related, but not clinical context. The Team Competencies Instrument shares a similar structure to scales employed by other teamwork skills evaluations, for example, the Comprehensive Assessment of Team Member Effectiveness or CATME.[23,24]

Following calculation of individual student IRAT scores and team TRAT scores, descriptive statistics were employed to explore the

Table 1
Individual readiness assessment test (IRAT) results.

Profession	N	Session 1: Safety	N	Session 2: Ethics	N	Session 3: Disparities
		IRAT		IRAT		IRAT
		Mean (SD)		Mean (SD)		Mean (SD)
Audiology	10	47 (21)	10	55 (19)	9	57 (24)
Dental	83	47 (20)	82	56 (20)	82	63 (15)
Medicine	137	50 (22)	134	57 (19)	135	66 (16)
MPH*	26	37 (30)	29	44 (25)	33	60 (18)
Nursing	64	54 (21)	63	53 (19)	60	62 (19)
Occupational therapy*	45	59 (19)	46	63 (19)	44	59 (18)
Physician assistant	60	43 (21)	60	51 (18)	58	65 (18)
Pharmacy	127	51 (19)	127	51 (18)	124	60 (18)
Physical therapy	55	59 (20)	44	50 (30)	55	62 (11)
Speech and hearing	32	47 (20)	31	50 (14)	31	67 (11)
Total	639	50 (22)	626	53 (20)	631	62 (17)

* $p < .05$.

data. Individual responses to the team competencies instrument were averaged within teams to determine a teamwork score. A two-way ANOVA was used to explore the relationship between students' IRAT scores over time and their profession. Additionally, linear regression was used to explore the relationship between TRAT scores and students' teamwork skill evaluations.

Results

IRAT and TRAT scores were collected from 639 students during session one, 626 students during session two and 631 students during session three (100% response rate for each session). IRAT performance varied across the three sessions by profession. Table 1 presents IRAT scores by profession for each session. A one-way repeated measures ANOVA revealed statistically significant differences in student IRAT performance both over time and based upon profession in each of the three sessions [$F(1,9) = 4.35$, $p < .01$]. Over the course of the three IRAT assessments, occupational therapy, physical therapy, medicine, and nursing emerged as high performers, respectively. Student performance increased over time ($p < .01$), but only two professions (Occupational Therapy and Public Health) had statistically significant differences in their overall longitudinal performance. As expected, TRAT scores were significantly greater than IRAT scores in each of the three sessions ($p < .01$), with averages scores of 83.01, 80.2 and 83.73% correct across the three team assessments (Table 2).

A total of 619 (98.1%) students completed the teamwork competencies instrument. Table 3 presents the mean score and standard deviation for each item. Overall, students indicated team members engaged in the team behaviors described by the instrument, with averages of 4.80 or higher on a 5 point scale. Students also agreed team members contributed equally, and few students indicated a member did not “pull his/her weight” on the team.

A regression analysis evaluating the relationship between reported team skills variables and team's average TRAT score over the three sessions provided evidence of a statistically significant association (adjusted $R^2 = .012$; $p = .04$). Specifically, “Exceptional contribution by one student” was positively related to TRAT scores.

Table 2
Team readiness assessment test (TRAT) results.

IPLH session	TRAT	
	N	Mean (SD)
Session 1: Patient safety	91	83 (09)**
Session 2: Ethics	91	80 (17)**
Session 3: Health systems	9	82 (05)**

** $p < .01$.

Table 3
Student evaluation of teamwork competencies.

	Mean	Std. deviation
Team members contribute to team meetings by initiating, seeking and giving information, clarifying, summarizing, taking consensus and being accountable[a]	4.86**	.40
Team members maintain positive group communication by encouraging, resolving conflict, acknowledging feelings, setting standards and maintaining openness to new ideas[a]	4.90**	.35
Team members display a positive attitude by valuing team decisions, demonstrating high regard and respect for all members, fostering mutual trust, being open to feedback and sharing a team vision[a]	4.89**	.35
One or more individuals on the team did not ‘pull their weight’[b]	1.43**	.85
Everyone on the team contributed approximately equally[b]	4.45**	.99
One person on the team was an exceptional contributor to the team's efforts[b]	3.06**	1.04

** $p < .01$.
[a] Participants evaluated questions with a five-point Likert-style response: strongly disagree (1), disagree (2), neutral (3), agree (4), strongly agree (5).
[b] Participants evaluated questions with a five-point Likert-style response: never (1), rarely (2), occasionally (3), regularly (4) to consistently (5).

Conclusions

Team-based learning is demonstrated to be an effective educational approach for students and is used in medical and health professions education.[8,10,11,25] Little has been reported about its application within interprofessional learning settings. Ohtsuki and Matsui briefly describe their use of TBL with interprofessional learners, concluding it is a practical approach for providing a large number of students instruction. Because of a faculty resource intensive first-year student IPE experience at our institution, like Ohtsuki and Matsui, we sought a less resource intensive teaching format and introduced TBL to promote both students' content knowledge in common curricula topics and further application of their teamwork skills.[26] Our results suggest TBL can be an effective means of educating interprofessional groups of learners around specific content areas and simultaneously promoting the application of teamwork skills. Our findings that TBL fosters content knowledge acquisition in an interprofessional setting are congruent with evidence reported by others in the literature when the teaching method is applied with uni-professional students.[8,10,11] We found that particular groups of health professions students performed better on some content specific individual readiness assurance measures. It may be that the content presented was already familiar to some students, not of as much interest to others, or that academic program factors such as competing exams or projects prompted students to perform differently. Some groups of health professions students performed better over time on the content specific individual readiness assurance measures. This may again reflect the aforementioned barriers.

Our findings that TBL contributes to the application of teamwork skills in an interprofessional learning context confirms what others have discussed regarding TBL as an active learning approach that should strengthen teamwork skills.[7] Our findings that the specific elements of teamwork, i.e., contributions of a single member, are associated with improved team performance are congruent to research that emphasizes the importance of leadership in teamwork.[27] Furthermore, our results move the examination of team

performance outcomes to students' actual use of teamwork skills in TBL, and not to structural features of the team (i.e., size and gender).

While much of the literature examining interprofessional education and outcomes focuses on clinical outcomes, our findings situate the link between improved interprofessional team performance and teamwork skills in a particular learning context, that of TBL.[28] Students' recognition of a team member's contributions reflects acknowledgement that input from a particular member was valuable. In the realm of interprofessional collaboration, acknowledgement of roles and responsibilities, including unique professional knowledge and skills, is a core competency. That more effective interprofessional team performance, i.e., contributions of particular individuals, is associated with improved performance in TBL further indicates that TBL can be an effective method for learners to apply teamwork skills within an interprofessional education program.

There are several limitations to this study. This study did not include a control group and there was no a priori assessment of teamwork skill, attitudes or competency, providing significant threat to validity. Further, for a minority of students ($n = 237$, 37%), this experience was their first large interprofessional learning activity due to the inability to participate in PFF. The team competencies instrument, while developed and shared from another institution, has not been rigorously validated for its psychometric properties. Other instruments may assess different elements of teamwork and lead to different results. While some suggest that a minimum number of 20–25 hours of TBL are necessary for maximum effect of team cohesion, our results were based on a limited number of TBL sessions.[14] This is similar to the Thompson et al study in which students participated in a small number of sessions.[14] It may be that given some students' previous opportunity to apply teamwork skills in their first-year IPE experience, their teamwork skills are more advanced in the second year curriculum; a minimum number of hours necessary to form and work as an effective team could thereby be reduced.

As an educational method, TBL has been demonstrated as effective for individual learners to improve their knowledge. Use of TBL in IPE appears to be effective for both content knowledge acquisition and application of teamwork skills, yet additional research is necessary including studies that make sure of more rigorous research design to eliminate confounds and bias. Given the resource demands of IPE, TBL offers an efficient approach for promoting interprofessional learning.

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