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A Survey of Student Perceptions of Team-Based Learning in Anatomy Curriculum: Favorable Views Unrelated to Grades

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Team-based learning (TBL) combines independent out of class preparation with in class small group discussion. We adopted TBL in teaching first year medical gross anatomy. In this study, we evaluated student perceptions of TBL by using a survey that elicited perceptions of both pedagogy and mode of learning. Anatomy lectures were replaced with required preclass readings, self-assessment quizzes, small group discussions of assignments, and groups retaking the same quizzes for deeper learning. At the course conclusion, students were surveyed to assess their preference for TBL, their perceptions of TBL effectiveness, and their perceptions of successful interpersonal relationships within groups. Respondents (n = 317; 89% response) were asked to rate the extent that they agreed (−2 = strongly disagree; −1 = disagree; 0 = neutral; 1 = agree; and 2 = strongly agree). A principal components factor analysis with varimax rotation identified two 8-item factors: "perceptions of TBL" and "perceptions of teamwork." Internal consistency for each was high [Cronbach's alpha = 0.908 (preference for TBL); 0.884 (preference of teamwork)]. Results of one-way analysis of variance between Honors/High Pass/Pass/Fail students indicated that Honors (n = 73) tended to rate perceptions of TBL higher than Pass (n = 54) [mean difference = 2.92; 95% CI (0.05, 5.79)], and also higher than Fail (n = 11) [mean difference = 6.30; 95% CI (1.13, 11.47)]. However, each had overall positive ratings. No difference was noted between mean ratings of teamwork, which were also, overall, positive. We conclude that medical students view TBL favorably irrespective of their grades. Anat Sci Educ 2:150–155, 2009. © 2009 American Association of Anatomists.

Key words: gross anatomy teaching; team-based learning; student perception; survey

INTRODUCTION

There is growing evidence that team-based learning (TBL) is an effective way of incorporating interactive small group peer teaching and enthusiasm for learning (Parmelee, 2007). Increasingly, courses are being taught using TBL in both undergraduate and graduate medical education (Michaelsen and Sweet, 2007; Seidel and Richards, 2001). Recent reports include the use of TBL in anatomy teaching (Nieder et al., 2005; Vasan and DeFouw, 2005; Vasan et al., 2008). As medical schools are creating integrated and interdisciplinary courses during the preclinical years, TBL is particularly useful because of its emphasis on teamwork, mastery of content, and problem solving for clinical application. TBL is an attractive strategy to adopt for medical gross anatomy, because it requires students to learn anatomical facts, from which they construct anatomical concepts for clinical problem solving (Nieder et al., 2005; Vasan and DeFouw, 2005; Vasan et al., 2008). TBL also requires regular preparation and attendance.

In 2004, the New Jersey Medical School (a large US East Coast public medical school in an urban area) introduced a comprehensive new curriculum including an increase in active learning modalities with a concomitant decrease in lecture time. In the anatomy course, laboratory dissection time was minimally reduced, basic anatomy lectures were eliminated, and TBL was introduced. A series of organized learning

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activities were provided to help students build baseline facts into a framework of conceptual interpretation and understanding (Vasan and DeFouw, 2005; Vasan et al., 2008).

Studies have shown that TBL increased learner's engagement and preparedness, improved problem solving, communication and teamwork skills, and knowledge outcomes (Thompson et al., 2007; and references therein). However, a systematic analysis of student experience or perception of TBL strategies has not been performed. The purpose of this study was to evaluate students' perceptions of their TBL experiences using a questionnaire survey that elicited not only perceptions of pedagogy but also how perceptions may be related to learning inventory and process.

METHODS

Because of the diverse backgrounds of our students the course coordinators stratified the "small groups" (Vasan et al., 2008). The course contained no basic anatomy lectures, but included didactic presentations of embryology and four to five clinical correlation lectures. A total of 175–180 first-year medical students were assigned to teams of eight and 18 team encounters (discussions) occurred during the semester. TBL involves three phases. In Phase 1, we assigned readings from required textbooks, *Clinically Oriented Anatomy* (Moore and Dalley, 2006), *Gray's Anatomy for Students* (Drake et al, 2005), and *The Developing Human: Clinical Oriented Embryology* (Moore and Persuad, 2007) and created 'learning issues.' These issues were based on textbook readings, assigned cadaver dissections, supplemented by *Grant's Dissector* (Tank, 2008), and one of two anatomy atlases: *Grant's Atlas of Anatomy* (Agur and Dalley, 2005) or *Atlas of Human Anatomy* (Netter, 2006). Learning issues focuses on clinical conditions that require application of anatomical knowledge and critical thinking (learning issues are available on request). Students are required to use only the textbook, atlas, and dissector (review books are excluded).

In Phase 2, all team encounters started with an ungraded multiple-choice quiz-(MCQ) (10 min) that was taken individually. Individual quizzes were immediately scored and this allowed us to monitor each student's level of preparation and enabled feedback when warranted. Following the individual quiz, teams discussed the assigned learning issues (90 min) to foster deeper understanding of the issues' concepts. The authors (N.S.V. and D.O.D.) monitored the team discussions, provided clarification on issues where students had difficulties, asked probing questions, and provided feedback when necessary. Following the discussions, teams collectively retook the individual quiz, by discussing each question (20 min) and selecting one common answer. Immediate Feedback Assessment Technique forms (IF-AT® Epstein Educational Enterprises, Cincinnati, OH) were used for the group quizzes. This form helped students identify incorrect answers immediately and discuss questions more in depth, thus facilitating deeper understanding of the materials. IF-AT® answer sheets contain rectangles (marked A, B, C, D, or E) for each MCQ. After the team agrees on an answer choice, a thin opaque covering on the chosen rectangle is scratched off. If the answer is correct, a star appears within the rectangle and full credit is received. If the answer is incorrect, further discussion within the team creates additional choices until the correct answer is identified. No credit is received for the additional choices.

Course Structure

The Human Anatomy course, which is offered in the fall semester, is divided into three units—thorax, back, and upper extremity (6 weeks); head and neck (5 weeks); and abdomen, pelvis, perineum, and lower extremity (8 weeks). Approximately 60% of course time is spent on cadaver dissection in small groups (four students per cadaver). Faculty coverage of the laboratory (40–43 tables) is as follows: every 10–11 dissection tables (40–44 students) is covered by a single faculty member, while the course coordinators "float" among the entire 40–43 dissection tables. In addition, embryology, and clinical correlations are presented as lectures.

Peer Evaluation

Evaluations of teammates within each team were collected after the unit examinations for internal use only. These evaluations enabled proactive counseling of the few students who initially received low scores from peers.

Student Assessment

The students take three-graded MCQ unit examinations (see course structure explained earlier), which are based solely on clinical vignettes. The examinations are taken both individually (Scantron® form-scored) and by teams (IF-AT® form-scored). Teams are also allowed to challenge any examination answers, and if a challenge is accepted, the result is applied to the entire class. The comprehensive final examination consists of the National Board of Medical Examiners (NBME) Anatomy and Embryology Subject Examination and is taken individually only. NBME examinations for various subjects are made available to medical schools for a fee, and are administered according to their guidelines. The NBME scores the examination and the grades are sent via e-mail to the Office of Education. Course grades are determined as follows: 40% from the unit examinations, 15% from the NBME final, 30% from practical examinations, 10% from the team unit examination grades, and 5% peer evaluation grades.

Search Strategy to Identify Available Instrument

A systematic literature search of MEDLINE (1966–2008) and CINAHL (1982–2008) via OVID attempted to identify articles relevant to TBL student satisfaction and TBL student experiences. Key words and the mesh-words used in the search MEDLINE were re-executed in CINAHL. All articles that matched our search terminology failed to identify a survey instrument that addressed our evaluation needs. Hence, we developed a valid and reliable instrument to measure student perceptions of TBL.

The Questionnaire

Anatomy faculty conducted focus group meetings with students to share their thoughts and suggestions for improving the course. The focus groups (10 in 2 semesters) helped us create a formal questionnaire to elicit student feedback about their experiences with TBL (see Appendix). In brief, the questions probed student's preparation for team discussions, usefulness of learning issues for acquiring knowledge, importance of

Table 1.

Items Within Factors Identified Through Principal Components Analysis

Factor	Items
Perceptions of TBL	TBL helped me prepare for course examinations
	TBL helped me increase my understanding of the course material
	The GRAT group discussions allowed me to correct my mistakes and improve understanding of concepts
	Learning issues helped me to focus on core information
	I learned useful additional information during the TBL sessions
	Discussions of the TBL learning issues were useful learning activities
	The TBL format was helpful in developing my information synthesizing skills
	Individual readiness assurance tests (IRAT) were useful learning activities
Perceptions of Teamwork	My team worked well together
	There was mutual respect for other teammates' viewpoints during TBL
	I have a positive attitude about working with my peers
	Most students were attentive during TBL sessions
	I contributed meaningfully to the TBL discussions
	The ability to collaborate with my peers is necessary if I am to be successful as a student
	Solving problems in a group is an effective way to practice what I have learned

group discussion for deeper understanding, and attitudes about team behavior and mutual respect during team discussions.

Comparison Analysis

In addition to questions related to perceptions of TBL, students were asked to provide the grade that they anticipated receiving in the course prior to administration of the final examination: Honors >90%; High pass 80–90%; Pass 70–80%, and Fail <70%. We then used these grading categories to compare student responses on the two scales that were created using analysis of variance (ANOVA) with Bonferroni corrections to control for multiple testing effects. Results were considered significant if $P < 0.05$.

RESULTS

The questionnaire was administered at the end of the course before the final examination, and was computer analyzed from the Scantron® sheets that remained confidential to the researchers. Cohorts from two classes (academic years 2006–2007 and 2007–2008) were studied. Of the 355 students (99% of the class), 38 respondents were not used due to missing data. No missing data imputation strategies were used, thus, the final sample size included 317 (90%) respondents. A principal components factor analysis with varimax rotation was conducted on the complete data set and yielded two 8-item factors with Eigen values greater than 1.0. The 16 items comprising the two factors were determined to represent "perceptions of TBL" and "perceptions of teamwork" (Table 1). Internal consistency for each factor was assessed using Cronbach's alpha coefficient and was 0.908 (preference for TBL) and 0.884 (preference for teamwork).

Of the 317 students, two did not respond to the question regarding expected grade, yielding a final sample of 315. Of those, the expected course grades before the final examination were: Honors 23.2%, High Pass 56.2%, Pass 17.1%, and Fail 3.5%. After the final NBME Anatomy and Embryology Subject Examination, the actual grade distribution was: Honors 24.5%, High Pass 59.0%, Pass 15.5%, and Fail 1.0%. Given that each factor was comprised of eight items, and each item was scored as –2, –1, 0, 1, or 2, the possible scores for each factor ranged from –16 to +16, with positive numbers representing a favorable view. Overall, the mean average score of the perceptions of TBL factor differed ($P = 0.003$) by the student's expected final grade. Specifically, Honors students rated perceptions of TBL higher than Pass students [mean difference = 2.92; 95% CI (0.05, 5.79)], and higher than Fail students [mean difference = 6.30; 95% CI (1.13, 11.47)]. However, as shown in Figure 1, each group had overall positive ratings of their perception of TBL.

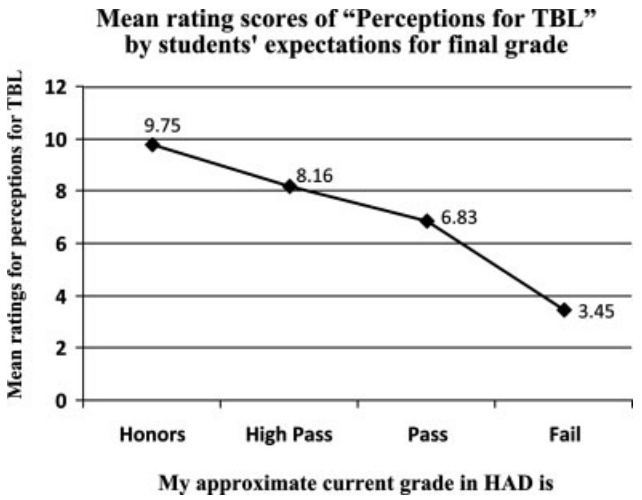

Figure 1.

Mean ratings of students who expected a grade of Honors, High Pass, Pass, and Fail, respectively. One-way analysis of variance indicated a significant overall difference in mean ratings ($P = 0.003$).

Figure 1 contains mean responses for each group's rating of perception of TBL. There were 23.2, 56.2, 17.1, and 3.5% students who were respectively expecting a grade of Honors, High Pass, Pass and Fail. One-way ANOVA indicated a significant overall difference in mean ratings ($P = 0.003$). Bonferroni posthoc testing indicated a statistically significant difference between Honors and Pass students ($P = 0.044$), and Honors and Fail students ($P = 0.008$). No differences were noted between mean ratings of teamwork as shown in Figure 2. One-way ANOVA indicated there was no significant overall difference in mean ratings ($P = 0.084$).

DISCUSSION

Our approach to use TBL allowed us to replace anatomy lectures with learning issues that enabled students to work individually and as a team in learning anatomy. Compared with passive learning associated with traditional lectures, team interactions allow more active student participation that fosters both activation of prior knowledge (Haidet et al., 2004) and active knowledge construction (Schmidt et al., 1989).

We made two interesting observations from this study: perceptions of TBL among high-performing students are significantly greater than among low-achieving students (Fig. 1); nonetheless, all students had positive perceptions of TBL (Fig. 2). How do we interpret these findings?

As the culture of medical education has traditionally emphasized the value and legitimacy of didactic lectures, learners who find themselves in a situation where traditional methods were replaced by interactive learning and peer teaching might perceive these methods less useful (Haidet et al., 2004). Furthermore, didactic presentations provide an "expert" to simplify and deliver a complex concept to novices (Palmer, 1998). In a recent study based on learning outcomes, students rated didactic presentations higher than other forms of teaching, including TBL (Jelsing et al., 2007). The authors suggested that these students might have based their ratings on amounts learned for test preparation purposes, considering examination performances were the most recently assessed outcome. Moreover, these students may have encountered difficulty assessing their perceived learning from more innovative teaching methods such as TBL. On the basis of these observations, we propose the concept that high-achieving students more readily overcame these negative implications and successfully used interactive learning for their mastery of anatomy. It is also possible that the high-achieving students had prior experience in active learning and adapted more readily to the benefits of this method.

The second observation reflects on student's ability for self-assessment. Based on their performances (not including the final), only the failing students made inaccurate predictions about their grade outcomes. Eight of eleven students who anticipated a failing grade actually received passing grades. Of 311 students who expected to pass the course many performed better than their anticipation. Most studies among health profession students have concluded that self-assessment is in fact poor (Ward et al., 2002; Eva and Regehr, 2005; and references therein). We feel that the eight students who under estimated their performances were able to bridge the gap in their knowledge and made appropriate adjustments. It is also equally possible that consequences of failing might have caused changes in their behavior that resulted in better performance. This agrees with the earlier statement, "there are moments when confidence and persistence in the face of negative feedback (in our case consequences of failing) may in fact be functional, and such persistence is more likely when feelings of self-efficacy are high regardless of past performance" (Eva and Regehr, 2005). Whether students are "accurate" self-assessors,

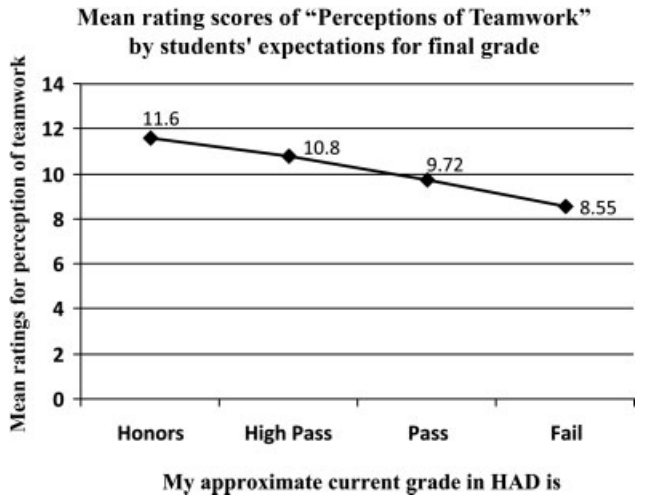

Figure 2.

Mean ratings of students who expected a grade of Honors, High Pass, Pass, and Fail, respectively. One-way analysis of variance indicated there was no significant overall difference in mean ratings ($P = 0.084$).

depends on many factors. In TBL, students receive frequent feedback from quiz performances, peers and faculty. This allows a constant cycle of identifying knowledge gaps, addressing these deficits and thereby fostering abilities for self-assessment.

In our implementation of TBL, we previously reported improved student's performance (Vasan and DeFouw, 2005; Vasan et al., 2008). Although our past studies highlighted learning and outcomes, this study, as suggested by Bordage et al. (1998), measured additional outcomes beyond learning. Here, we measured long-term and lasting outcomes such as ability to work in teams, mutual respect for team members and contributions to team efforts (Figs. 1 and 2). These data provided an objective measure of the perceptions of first year medical students about TBL. The use of multiple outcome measures in this study exposed an interesting tension between learners' performance and learners' perceptions of the value TBL. This deserves further study. We hope the acceptance of the value of teamwork among all students (Fig. 2) is a long lasting attribute that will continue through their professional life and contribute to more effective clinical practice. Hopefully, our results will prompt other adopters of TBL or cooperative learning to pursue similar studies, not only to confirm our findings, but to strive to ask more clarification questions, as recently suggested (Cook et al., 2008).

CONCLUSION

Our experience in implementing TBL has been positive with improved students' performances and faculty satisfaction. We still continue to adjust various aspects of the course in response to student's feedback and our own vision. In this study, we have investigated other outcomes. Although higher performing students tended to perceive TBL more favorably than lower performing students, overall, there was strong positive support for TBL. Furthermore, a large majority of students expressed positive feelings about teamwork.

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APPENDIX

Questionnaire

Directions: Please circle the number for each phrase that best describes the extent to which you agree with the following statements about TBL: A = Strongly Disagree, B = Disagree, C = Neutral, D = Agree, and E = Strongly Agree. Please use the Scantron® form.

1. TBL helped me increase my understanding of the course material.	A	B	C	D	E
2. I have completed 100% of the required reading.	A	B	C	D	E
3. Learning issues helped me to focus on core information.	A	B	C	D	E
4. Individual readiness assurance tests (IRAT) were useful learning activities.	A	B	C	D	E
5. I generally felt prepared for the IRAT.	A	B	C	D	E
6. Discussions of the TBL learning issues were useful learning activities.	A	B	C	D	E
7. I learn better from lecture presentations than small group.	A	B	C	D	E
8. Solving problems in a group is an effective way to learn anatomy.	A	B	C	D	E
9. I learned useful additional information during the TBL sessions.	A	B	C	D	E
10. TBL helped me prepare for course examinations.	A	B	C	D	E
11. The GRAT (group) discussions allowed me to correct my mistakes and improve understanding of the concepts.	A	B	C	D	E
12. I have a positive attitude about working with my peers.	A	B	C	D	E
13. The ability to collaborate with my peers is necessary if I am to be successful as a student.	A	B	C	D	E
14. Solving problems in a group is an effective way to practice what I have learned.	A	B	C	D	E
15. My team worked well together.	A	B	C	D	E
16. I contributed meaningfully to the TBL discussions.	A	B	C	D	E
17. Most students were attentive during TBL sessions.	A	B	C	D	E
18. I paid attention most of the time during the TBL sessions.	A	B	C	D	E
19. The TBL format was helpful in developing my information synthesizing skills.	A	B	C	D	E
20. There was mutual respect for other teammates' viewpoints during TBL.	A	B	C	D	E
21. My approximate anticipated grade in HAD is H = A; HP = B; P = C; and F = D.	A	B	C	D	