The Efficacy of Team-Based Learning in Histology

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ABSTRACT

Team-Based Learning (TBL) is an instructional strategy in which traditional lectures are replaced with in-class activities that promote group discussion and active learning. Students are expected to master the basic facts and concepts of the subject matter prior to coming to class. We sought to determine whether the knowledge obtained using TBL is comparable to that obtained using traditional lectures, and whether students have a preference for either instructional method. From 2006-2008, the students in a graduate histology course were taught the structure and function of the basic tissues using TBL. Other topics in the course were taught using lectures, so the students experienced both instructional methods. Using the same 59 multiple-choice questions, we tested the students' knowledge about the basic tissues, and compared the results to those obtained in 2005, when the basic tissue material was taught using lectures. In 2006-2008, the mean ± SD exam performance after TBL (87.5 ± 7.5, n = 32; 83.9 ± 11.1, n = 36; 78.9 ± 13.2, n = 24) was similar to that observed in 2005 after lectures (82.7 ± 12.0, n = 39). When asked to respond to the statement, "I prefer TBL sessions rather than traditional lectures", 40.4% of the students agreed or strongly agreed, 23.4% disagreed or strongly disagreed, and 36.0% had no opinion (89 of 92 students responding). These results suggest that TBL and lectures produce comparable learning outcomes, at least as measured on a multiple-choice exam, and that students have a mild preference for the TBL format.

BACKGROUND

- Medical histology courses around the country are under pressure to reduce lecture hours and engage the students in more active forms of learning.

- This trend is coupled with ongoing curricular reforms at many of the nation's medical schools, including our own, aimed at "integrating" the basic and clinical sciences. The assumption is that students will better understand and retain the basic science material if it is presented in a clinically-relevant context.

- **Team-Based Learning (TBL)** is a unique pedagogy in which traditional lectures are replaced with in-class group activities. Students are expected to master the basic facts and concepts of the subject matter prior to coming to class.

- We tested the hypothesis that students who learn via TBL perform as well as students who learn via traditional lectures.

METHODS

- For three consecutive years (2006-2008), we replaced 8 one-hour lectures covering basic histology topics with 4 two-hour TBL modules:
  1. **Epithelia and Connective Tissue**
  2. **Muscle and Nerve**
  3. **Blood and Lymphoid Tissue**
  4. **Cartilage and Bone/Cardiovascular System**

- Each TBL module consisted of an iRAT, gRAT, and Application Exercise, described in the next text box. No lectures were given.

- Students were randomly assigned to teams of 5-7 members.

- At the conclusion of the 4 TBL modules, students were tested using 59 multiple-choice questions, the same questions used to test the students when the material was presented via lectures in 2005 (**RESULTS I**).

THE TBL SEQUENCE

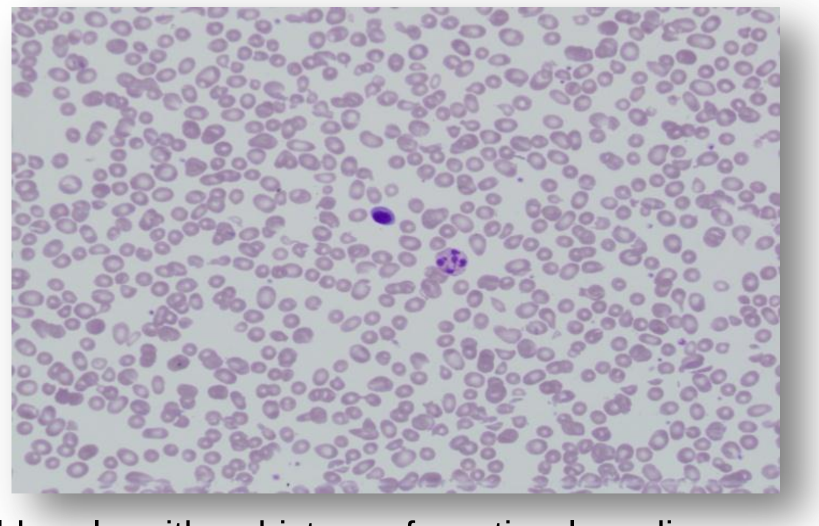
- At the beginning of each TBL session, all students take a 10-question **individual Readiness Assessment Test** or **iRAT** (15 min). The purpose of the iRAT is to assess each student's knowledge of the basic material and preparation for group activity.

- Each team then answers the same 10 questions again, but this time working as a group (15 min). This is called the **group RAT** or **gRAT**. The team discusses the questions until a consensus is reached about the correct answers.

- After completing the RATs, each team works through an **Application Exercise** consisting of 8 or 9 challenging questions that require synthesis of information and higher-order reasoning (60 min). Many of the questions are clinically-oriented and are not answerable unless the team accesses external sources of information. Each team is provided with an unabridged medical dictionary and a copy of The Merck Manual.

- After the teams' answer sheets have been collected, the instructor sequentially reviews each of the questions on the Application Exercise and asks the teams to "simultaneously report" their answers (30 min). This is be done by holding up a colored card that denotes the team's answer to a given question. In this way, all of the teams can see each other's answer at the same time. Teams with different "correct" answers are asked to explain/defend their choices (**RESULTS II**).

EXAMPLE OF APPLICATION EXERCISE QUESTION



A 67 year-old male with a history of peptic ulcer disease and gastritis visits his doctor for a check-up. The physical exam is normal, though the patient has lost weight since his last visit. The patient has no complaints other than some GI discomfort he attributes to his ulcers and "just getting old". However, his RBC count indicates anemia. Microscopic examination of blood smears reveals a high percentage of erythrocytes that are much larger than normal and a reduced number of reticulocytes (reticulocytopenia). What should the doctor do?

a. Treat the patient with antibiotics for *Helicobacter pylori* infection.

b. Recommend genetic testing to rule out beta-thalassemia.

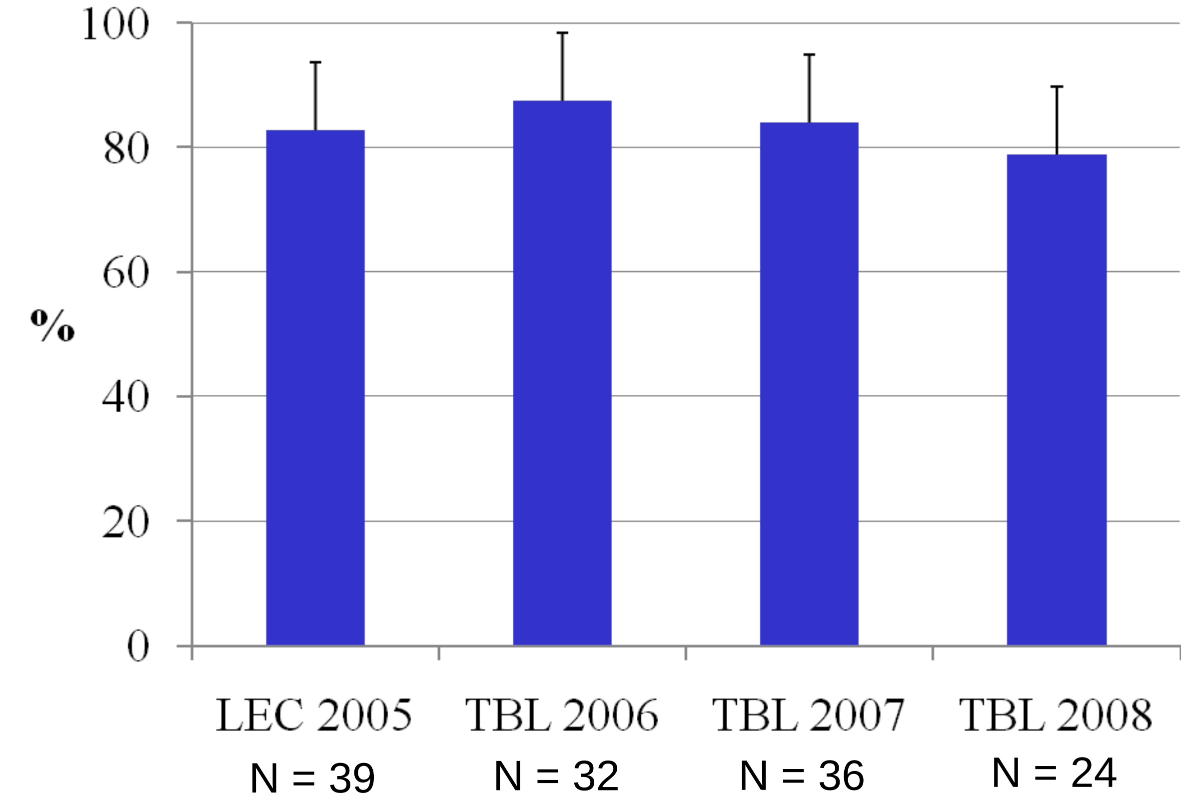
c. Prescribe dietary iron supplements.

d. Evaluate the patient for evidence of occult gastric bleeding.

e. Measure serum levels of vitamin B_{12} to see if deficient.

RESULTS I

LECTURES AND TBL PRODUCED COMPARABLE LEARNING OUTCOMES



Mean ± SD percent correct exam scores after lectures in 2005 and after TBL in 2006-2008. In all cases, the same 59 multiple-choice questions were used to assess students' knowledge of the material.

RESULTS II

STUDENTS LEARNED THE ASSIGNED MATERIAL BEFORE COMING TO CLASS, AND THEY WORKED TOGETHER COLLABORATIVELY

Year	TBL Module 1			TBL Module 1			TBL Module 3			TBL Module 4		
	iRAT	*gRAT*	*ApEx*	*iRAT*	*gRAT*	*ApEx*	*iRAT*	*gRAT*	*ApEx*	*iRAT*	*gRAT*	*ApEx*
2006 n=32	86.3	100	82.2	91.0	100	65.0	79.4	97.0	97.5	81.1	96.5	85.0
2007 n=36	88.0	98.8	75.8	94.0	100	69.2	78.0	96.3	100	74.0	95.0	91.7
2008 n=24	86.0	98.8	82.5	82.0	100	57.5	78.0	96.3	97.5	72.0	94.5	82.5
$\bar{x}$ n=92	**86.9**	**99.2**	**79.8**	**89.8**	**100**	**64.7**	**78.5**	**96.5**	**98.5**	**75.9**	**95.4**	**87.0**

Percent correct scores for each component of the TBL modules. All members of a given team earned individual iRAT scores, but they shared the team's scores earned on the gRATs and Application Exercises because these were group activities. Collectively, the scores from the four TBL modules constituted 12.5% of the student's course grade.

STUDENT OPINION

STUDENTS EXPRESSED A FAVORABLE OPINION OF TBL

1. "I prefer TBL sessions rather than traditional lectures."
   40.4% agree; 36.0% no opinion; 23.6% disagree

2. "I was able to identify the important elements of the material without a traditional lecture."
   68.5% agree; 12.4% no opinion; 19.1% disagree

3. "The Application Exercises enhanced my understanding of the material."
   56.2% agree; 22.5% no opinion; 21.3% disagree

4. "The TBL sessions assisted my learning of the material better than a traditional lecture."
   39.3% agree; 34.8% no opinion; 25.8% disagree

(With 89 out of 92 students responding)

SUMMARY AND CONCLUSIONS

- Our findings suggest that TBL and lectures produce comparable learning outcomes, at least as measured on a multiple-choice exam.

- The students take the TBL process seriously. They study the relevant learning materials (class lecture notes and textbook reading assignments) prior to coming to class, and they demonstrate a good understanding of the subject matter, as evidenced by their iRAT scores.

- The students demonstrate effective teamwork, as evidence by their gRAT scores and, more importantly, their group performance on difficult Application Exercises. Students rarely miss TBL sessions. They seem to feel an obligation to their team-mates.

- Although there is not a strong consensus in favor of TBL, the majority of students appear to believe they can learn adequately without traditional lectures, and that the Application Exercises are useful.

REFERENCES

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