Team-Based Learning in a Majors/Non-Majors Neuroscience Course

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Abstract

Neuroscience 101: The College Brain is designed as a bridge course to help students transition between high-school and college. The course has no pre-requisites and is intended for 1st year college students. The course serves students majoring in Neuroscience (approximately 20% in the fall 2015 offering), other science majors (~14%), and non-science majors seeking to fulfill their lab requirement (~67%). The latter group typically consists of students from all academic levels (1st year – senior). Students completing earlier iterations of the course at Thiel College (2014) and Centenary College of Louisiana (2011-13; both taught by the author) demonstrated difficulty understanding readings and linking concepts from the readings to other course materials. To address this concern, in the fall 2015 a new team-based learning approach was integrated into the class. Here I report on this technique and present data from the pilot year.

Background

In the spring of 2015, Senior Associate Director of Northeastern University's Center for Advancing Teaching and Learning Through Research, Michael Sweet, Ph.D., lead a faculty workshop in which he presented material on the instructional strategy Team-Based Learning (TBL). As defined by the Team-Based Learning Collaborative (http://www.teambasedlearning.org/). TBL is a collaborative learning strategy organized around modules of instruction. The typical TBL structure requires students to read, watch, or complete materials related to the module before the start of instruction of that module. Students then complete an in-class Readiness Assurance Test/Quiz (RAT or RAQ), first individually then as a team (see details on my method below). Finally, the team completes of an in-class activity related to the material.

TBL is typically organized around four foundational principles (Michaelsen & Richards 2005):

- Individual talent, experience, and other relevant student characteristics are equally distributed among groups, which are fixed for the duration of the course.
- Students are held accountable for individual (pre-learning) and team work.
- Assignments are designed to promote learning and team development.
- Immediate feedback is frequently given in all stages of the module.

Following Dr. Sweet's presentation, I chose to implement TBL in my Neuroscience 101 course to address the concerns mentioned in the abstract above. Specifically, TBL was chosen to try help students better understand how pre-lab/lecture readings relate to other course materials. This class was selected as it serves a diverse group of students that frequently struggle with introductory level science courses. For example, all neuroscience majors begin their curriculum with this course. The class is also taken by a variety of other science majors; typically, those interested in health-careers. This group tends to consist of highly motivated 1st-year and sophomore students. Non-science majors can use the class to fulfill Thiel's lab-science core requirement. This group is more diverse in terms of their motivation and academic rank and frequently consists of students from all levels (1st-year through super-seniors). Demographics on for this iteration of the class are presented in Table 1.

Type of student		Academic Rank		Self-Reported	
Non-Science	67%	First Year	27%	Gender	
Science Majors	33%	Sophmore	7%	Male	60%
Neuroscience	20%	Junior	33%	Female	40%
Biology	7%	Seniors	33%		
Comp. Sci	7%				

Table 1: Student demographics for the fall 2015 offering of Neuroscience 101 (n=15).

Timeline

Prior to the start of the semester

- I assigned students to teams based on academic rank and prior coursework. Each team consisted of at least one science major and one 1st-year, junior, and senior student.

1st Lab Period: Pre-Readiness Assurance Quiz (RAQ)

- Students were introduced to the TBL format and given their team assignments. Their first task as a team was to decide on the grade weights for the three components of each RAQ (Figure 1). They then completed an individual and group pre-RAQ on the course syllabus. Group-RAQs were completed using IF AT ® scratch cards (Figure 2).

Approximately every three weeks: RAQ 1-4

- The remaining RAQs were given at the start of each new module. Each RAQ began with a 10-point individual quiz. Students then assembled into their teams and repeated the quiz using the IF AT ® cards (Figure 2). Full credit was awarded if the correct answer was uncovered on the first attempt; half credit if two choices were scratched. The rest of the period (~2.5 hours) was devoted to class discussion and lab activities related to the reading and that module of the course. Finally, after the la students assessed the preparation of their group members using TEAMMATES, an online peer evaluation system (https://teammatesv4.appspot.com/). A sample RAQ and peer-assessment is included in the folder below. A flow-chart for the time needed for each RAQ is presented in Figure 3.

Approximately 2-3 weeks following each RAQ: Exams 1-4

- Exam performance was used as a measure of student understanding of module content.

The RAQs will follow a team-based learning model, in which you will first complete the quiz by yourself, then as a team. Your grade for each RAQ will be based on three factors:

	Grade weight
• Your individual performance on the RAQ (**25-50%**)	___% (___ points)
• Your team performance on the RAW (**25-50%**)	___% (___ points)
• Your team maintenance (peer evaluation) (**15-30%**)	___% (___ points)
Total RAQs score	100% (20 points)

Figure 1: Excerpt from course syllabus describing the grade-weighting scheme for the RAQs. Working in teams students debated different weighting strategies. The class decided the ultimate scheme, within ranges (bold underlined values) pre-determined by the instructor. This exercise served as an ice-breaker for the teams, but also helped provide student buy-in for the grading scheme.

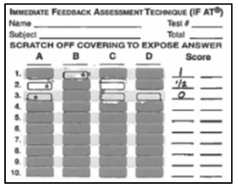

Figure 2: IF AT ® scratch card. These cards were used for all team RAQs. This system allows for partial credit for second attempts.

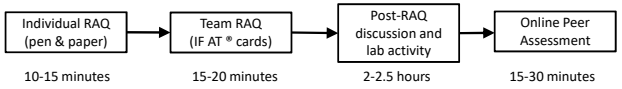

Figure 3: Time requirements for each RAQ

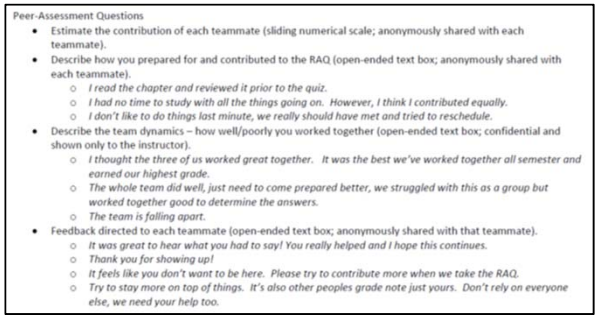

Figure 4: Peer evaluation questions and sample responses.

Results

In general science majors performed better than non-science majors on RAQs and Exams (Figure 5 and 6). A significant difference on RAQ grades was noted for both science and non-science majors (Figure 6), but not between exams grades. Furthermore, 1st year students and sophomores tended to perform better than juniors and seniors on both RAQs and Exams. A significant difference between academic ranks was observed in exam grades but not RAQs (Figure 7). No gender differences were noted.

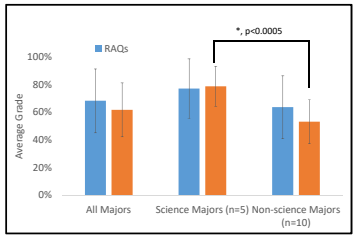

Figure 5: Summary grades for RAQs and Exams. Science majors performed significantly better than non-science majors on the exams (*, p<0.0005) and trended better the RAQs (p=0.08). Error bars represent standard deviation.

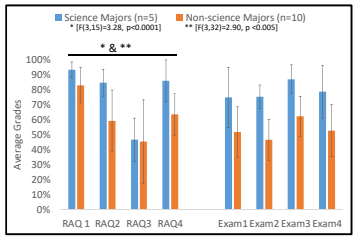

Figure 6: Average scores for each of four RAQ and Exam for science and non-science majors. A significant difference in performance on the RAQs was noted for both science majors(*) and non-science majors (**). No such difference was found within each groups exam grades. Error bars represent standard deviation.

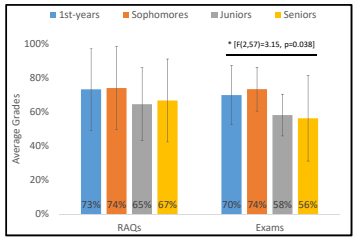

Figure 7: Summary RAQ and Exam grades grouped by students' academic rank. A significant difference between rank and exam grades, but not RAQs was found.

Conclusions

- Science majors and newer students generally performed better than their non-science major and upper-class peers on both RAQs and Exams, specifically on questions related to RAQ readings.
- The third RAQ was likely an outlier that made additional interpretation of the results difficult. This RAQ occurred immediately following our Fall Break and students commented they had not prepared adequately.
- A correlational analysis was performed to examine the relationship between RAQ and exam performance. Although limited in power, this analysis indicated that the relationship might be different for science and non-science majors and for lower and upper academic ranks. In all cases, a negative correlation was found between RAQ and exam grades for science majors and 1st-years/sophomore students. This could indicate a low RAQ scores motivated these students to spend more time preparing for an upcoming exam.
- Student comments at the end of the course indicated that most were frustrated with the group aspect of the project. All but one of the groups had substantially disruptive members that undermined the function of the team and made analysis of the efficacy of this project difficult.

Future Directions

As a pilot attempt at TBL, I believe the project had some success. For the one group that was able to work together, TBL appeared to successfully accomplish its goals. These students regularly discussed material outside of class, were more engaged with the course, and earned higher grades. Interpretation of the other groups was difficult as each had members that stopped coming to class and/or participating in any group work. The limited data collected in this pilot may indicate that TBL is an effective approach for students that are already motived to preform well in a course – namely students that are taking a course because it relates to their major or intended career.