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[Original Article]

Improving Student Learning through a Team-Based Learning Approach in a Retailing Math Course

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Abstract

Passive learning attitudes and lack of enthusiasm in a retailing math course is quite common and a significant number of students do express their frustrations and struggles by seeking extra help outside the classroom. In order to promote students' active participation in class and to improve their performance and overall satisfaction with the course, a modified team-based learning (TBL) method was implemented in a retailing math course in two consecutive semesters. Implementing TBL into a retailing math course would improve students' accountability for their own learning, increase student interactions and engagement, and develop teamwork and collaboration skills.

The scores on the midterm and final tests indicated that students' performance improved especially for the students who scored below 80% on each test when TBL was implemented. Students' reflection on the TBL activities done in class throughout the semester indicated that these TBL activities help them solidify the concepts taught in class better. They were able to realize their own mistakes and other group members who got the question right helped them understand. To maximize the benefit of TBL, it is suggested to implement TBL within the flipped classroom. Further research is called for to evaluate the effect of TBL on long-term knowledge retention among college students.

Keywords: Team-based learning, retailing math pedagogy, flipped-classroom

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I. Introduction

Buyers and merchandisers in the fashion industry spend enormous hours calculating gross margin and profit by crunching numbers into the system besides collecting fashion trend information, visiting fashion and textiles fairs, and meeting venders and suppliers around the world. Therefore, most fashion merchandising programs offer retailing math courses where students learn factors affecting profit, cost calculation with discounts offers, dating and shipping terms, markdowns, markups, open-to-buy, inventory management, assortment planning, and 6-month planning. Students are required to solve practical questions using retail math concepts and

formulas, which most first- or second- year fashion students do not expect to learn before they read the course syllabus on the first day of class.

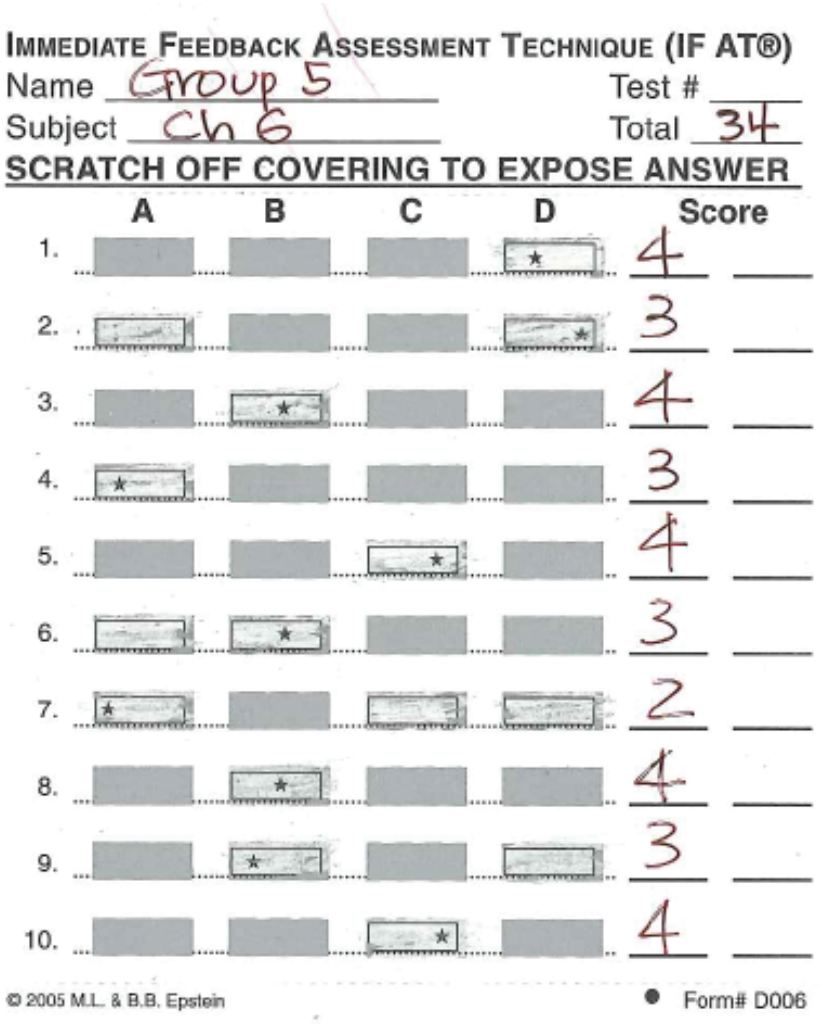
Therefore, passive learning attitudes and lack of enthusiasm in a retailing math course is quite common and a significant number of students do express their frustrations and struggles to the instructor by seeking extra help. In order to promote students' active participation in class and to improve their performance and overall satisfaction with the course, a modified team-based learning (TBL) method was implemented in a retailing math course in two consecutive semesters. Implementing TBL into a retailing math course would improve students' accountability for their own learning, increase student interactions and engagement, and develop teamwork and collaboration skills.

II. Background

Students often view mathematics as passively received knowledge, not as actively constructed knowledge (Selden & Selden, 2001). Students in the fashion merchandising program (fashion students) at the instructor's institution mostly complete the general education requirements in mathematics prior to the semester they register for the retailing math course; however, fashion students vary in their existing math operation skills, attitudes or emotion towards math, and retailing and merchandising experience. In the retailing math course, fashion students acquire new retail math knowledge such as profit and loss analysis, markups, markdowns, cost analysis, and sales and inventory planning using mathematical formulas and calculations in order to solve practical retailing and merchandising problems. The instructor has been taught the retailing math course in a conventional lecture setting; therefore, students often rely too much on lectured information or the instructor to acquire the fundamental knowledge while group work or collaboration among students is quite limited and actual application of the concept to practical problems is mostly left on students as homework. Some fashion students even experience math phobia that eventually blocks them from active learning and participation in classroom activities.

The retailing math course is one of the core courses required for students in the fashion merchandising program. Since the course focuses on retail math operations, students often need extra help to comprehend retail math concepts and applications and to complete their homework assignments. During the homework help sessions that were run in a small group setting, the instructor observed that students were asking questions each other and discussing their ways to solve the questions actively. Students who never spoke in class due to lack of confidence in general math skills even seemed feeling less intimidated to participate in group conversation. Even though the instructor encourages students to work collaboratively with peers in and outside the classroom, without implementing a more structured team-based learning method in the retailing math course, cooperative learning among students would be minimal.

In team-based learning (TBL), students need to study and prepare for class activities by taking an Individual Readiness Assessment Test (IRAT). Once they turn in their individual tests, students in the pre-assigned group by the instructor take the exact same test (Group readiness assessment test, GRAT) using an Immediate Feedback Assessment Technique (IF-AT, see Figure 1). With the IF-AT "scratch-off" form, the group receives full points if they get an item correct on the first try. If multiple tries are needed, the group receives points with deductions. The instructor has used the IF-AT form in this retailing math course since 2009. Since IF-AT allows students continue working on a question until they discover the correct answer, students the instructor taught in the previous semesters reported that the use of the IF-AT form reduces their test anxiety and helps learn even while being tested. Epstein and Brosovic (2002) reported that the use of the IF-AT form promote greater concentration and logical thinking than


IMMEDIATE FEEDBACK ASSESSMENT TECHNIQUE (IF AT®)
Name Group 5 Test # ____
Subject Ch 6 Total 34
SCRATCH OFF COVERING TO EXPOSE ANSWER

	A	B	C	D	Score	
1.				★	4	
2.				★	3	
3.		★			4	
4.	★				3	
5.			★		4	
6.		★			3	
7.	★				2	
8.		★			4	
9.		★			3	
10.			★		4	

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Figure 1. Sample immediate feedback assessment technique form used

traditional delayed-feedback tests. In GRAT, students compare their understanding with those of the group and must come to consensus on their group answers. When groups feel they can still make a case for their answers that were marked as incorrect or they can improve the question by rewording it, they can generate written appeals.

The major objective of TBL is to improve cognitive learning using personal knowledge within a collaborative team (Michaelsen, Parmelee, McHahon, & Levine, 2008), which is aligned with constructive learning theories. Hrynchak and Batty (2012) state that TBL enables students to develop critical thinking skills and teamwork abilities. Industry professionals consider communication and teamwork skills to be one of the essential skills taught in undergraduate programs (Kyhel, 2014; Plice & Reinig, 2009) and the fashion industry is no exception.

Jafari (2013) compared levels of student learning and student satisfaction between conventional lecture and team-based learning in a neurology course and found that student scores and student satisfaction from the TBL method were significantly higher than those from the lecture method. Mennenga and Smyer (2010) summarized student advantages of TBL to be active preparation for their classes, improved teamwork and interpersonal communication

skills, improved critical thinking and problem solving skills, enhanced comprehension and recall of materials, and higher student satisfaction.

To promote fashion students' active learning in the retailing math course, a modified TBL method was implemented especially to help students with passive learning attitudes toward math. In a TBL setting, students may feel that they are responsible for their contribution to the group work from which everyone shares the same grade. TBL as a form of cooperative learning also benefits students with high math anxiety since it builds small communities of learners by increasing liking among students, perceived social support from peers and instructors, and positive attitudes toward college (see Saville, Lawrence, & Jakobsen, 2012).

III. Methodology

At the beginning of the semester, students in the course took a diagnostic test on basic math skills and problem solving skills. Based on the results of the diagnostic test, demographics, and the instructor's experience with the students in the prerequisite course, the instructor formed groups strategically to ensure maximum diversity within the groups but relative evenness across the groups. In the first semester, there were six groups of five students and one group of four students while there were five groups of six students during the second semester.

Once the groups were formed, students should stay with the same group throughout the semester. After completing the chapters assigned to TBL, students took an individual readiness assessment test (IRAT) in class or submitted a homework assignment. Once they turned in their individual test or homework, students took the exact same test as a group (GRAT) in class. This time, the instructor provided the same questions with multiple choices using the IF-AT "scratch off" form. The group must answer them through a consensus-building discussion since the group share the same grade. IF-AT can provide an immediate feedback about the accuracy of their answers to each question. The group must continue working on the questions until all correct answers are revealed. If the group feels that the questions they didn't get are not fair or are poorly written, they can generate written appeals consisting of a clear statement of argument and evidence pulled out from the course materials. The instructor reviewed written appeals and based on the reasoning and the justification, additional points were given to the group and the question and answer options were revised based on the suggestions made by students. The instructor provided further clarification on the concepts or applications students struggled with during the GRAT to wrap up the chapter. In both semesters, four chapters out of the eight chapters covered in the semester were assigned to the TBL activity.

To determine an overall score for each student in TBL, the formula A + C = D was used. In this formula, A is the score in the IRAT, C equals Participation % * B, which is an adjusted GRAT score (B is the score in the GRAT), and D is the final score. To calculate Participation % for each student, students evaluate group members' contribution to the GRAT by distributing 100% across the group members (see Appendix 1). Students do not evaluate themselves. The instructor then added each student's percentages given by the group members and calculates an overall contribution percentage (P%) for each student. The individual participation percentage (P%) is calculated by dividing the sum of the percentages each student collected from the group members by the highest sum percentage in the group. Therefore, if a student' total percentage is the highest in the group, his/her participation percentage is 100%.

IV. Results

In order to examine the effect of TBL on student learning, students' scores on the midterm and final tests were compared to those on the similar tests done in the previous four semesters (see Table 1). Both midterm and final tests were cumulative. Students were tested on the first four chapters in the midterm test. The final test covers the other four chapters. TBL was implemented in two chapters for both midterm and final tests. Since the TBL method was incorporated to improve the performance of students who experience some challenges in the retailing math course, scores from students who scored below 80% on each test were also compared (see Table 2). In both tables, the TBL method was implemented in Semester 5 and 6.

Table 1. Mean scores on the midterms and final tests (all students)

Terms	*N*	Midterm		Final	
		M(%)	*SD*	*M(%)*	*SD*
Semester 1	30	73.27	0.16	83.05	0.14
Semester 2	27	70.59	0.25	75.93	0.25
Semester 3	31	76.26	0.11	78.16	0.11
Semester 4	34	76.62	0.12	75.99	0.09
Semester 5 (TBL)	33	87.22	0.11	76.16	0.10
Semester 6 (TBL)	28	81.47	0.11	79.18	0.08
Total	183	77.79	0.16	78.02	0.14

Table 2. Mean scores on the midterms and final tests (Below 80% on each test)

Terms	Midterm			Final		
	N	*M (%)*	*SD*	*N*	*M (%)*	*SD*
Semester 1	17	62.71	0.13	12	68.81	0.08
Semester 2	14	53.86	0.25	9	52.70	0.31
Semester 3	17	67.76	0.07	16	69.73	0.09
Semester 4	18	68.06	0.09	24	70.73	0.05
Semester 5 (TBL)	6	69.17	0.12	23	73.40	0.05
Semester 6 (TBL)	14	71.61	0.06	15	69.01	0.05
Total	86	65.28	0.14	99	69.01	0.12

An independent samples *t* test was performed comparing the mean consistency scores of the students from the semesters without TBL and those from the semesters with TBL on the midterm and final tests. The students with TBL ($M = 85.53\%$, $SD = .12$) scored higher than the students without TBL ($M = 74.37\%$, $SD = .17$), $t(182) = 4.324$, $p < .001$, two-tailed on the midterm tests. However, there was no significant difference found on the final test scores between students without TBL ($M = 78.26\%$, $SD = .16$) and those with TBL ($M = 77.55\%$, $SD = .09$). The test scores of the students who scored less than 80% on each test were also compared. There was a significant difference in the midterm scores for the students with TBL ($M = 70.88\%$, $SD = .08$) and those without TBL ($M = .63.59\%$, $SD = .15$), $t(84) = 2.043$, $p = .044$, two-tailed. An independent samples *t* test was also conducted to compare the test scores for the students who scored below 80% on the final tests. There was a significant difference in the final scores for the

students with TBL (M = 71.55%, SD = .05) and for those without TBL (M = 67.43%, SD = .15), $t(97) = 1.675$, p =.097, two-tailed.

In addition, the researcher asked students to write a short reflection on the TBL method on the last day of class to measure students' perception on TBL as a new teaching tool and their satisfaction with the course. Students' reflection on the TBL activities done in class throughout the semester indicated that these TBL activities help them solidify the concepts taught in class better. They were able to realize their own mistakes and the other group members who got the question right helped them understand. The following quotes are from the students' evaluation on the TBL method.

> "I enjoy group work because my classmates teach me valuable tricks I don't always understand during a lecture".
> "I enjoyed group work because I am able see how my classmates are doing".
> "I learn better from the group activities. I understand better from other students".
> "It helped me understand what I did not understand on the homework. I was not very sure of the homework; now I understand".
> "Everyone had different knowledge on different questions that was helpful".
> "Haring how other group members apply the formulas, come out of a fellow peers were easier to understand"
> "I learn better from actually doing the problems than taking notes about the concepts"

Overall, they agreed that the TBL method did help them learn better the materials covered in class. They also answered that they value collaboration and group efforts to find the correct answer. However, when all group members are not confident in their answers, students indicated that this group activity does not help them much.

V. Discussions and Conclusion

The aim of the instructor in incorporating a TBL component in a retailing math course is to improve students' comprehension and learning of retailing math concepts and applications. Among the eight chapters covered in a semester, the instructor chose four chapters to incorporate the TBL method replacing the traditional instructor-led problem-solving method. After students completed the individual preparation test, pre-assigned student groups collaborated to solve the same questions using the IF-AT form. The test scores on the midterm and final tests from the semesters administered without TBL (previous four semesters) and with TBL (two semesters) were compared. The results showed that students' mean scores on the midterm test were significantly higher when TBL was implemented. However, no significant different was found on their final test scores. The effect of TBL on students' test scores was also examined especially for students whose scores were below 80% on each test. On both midterm and final tests, students scored significantly higher when TBL was incorporated. Even though only the half of the chapters was assigned to the TBL method, a positive effect on student learning of the concepts and problem solving skills was observed. Students' reflection on this TBL method also supports that their participation in the TBL

activities did help comprehend the retailing math concepts better and easier. They also indicated that through the TBL activities done in class, they enjoyed solving rather difficulty retailing math questions together as a group.

Due to the time constraint, the instructor was not able to fully implement TBL in the course. Since students solely rely on the instructor to acquire new retailing math concepts and formulas given in lecture, adding the TBL activities into the existing lecture schedule without reducing the contents isn't always easy. In order to maximize the effect of TBL on active, constructive learning, the instructor recommends using TBL within the flipped classroom. In the flipped classroom framework, students are required to acquire foundational knowledge prior to class as homework and in class, students engage in active learning by solving challenging problems. The self-directed "lecture" happens before class and can be done online outside the classroom via pre-recorded lecture, video podcasts, or other available online materials. If students acquire the basic content such as retailing math concepts and formulas through online "lecture" before class, an instructor can challenge students to solve practical problems by applying retailing math concepts and formulas. Applying the fundamental concepts and formulas to different problems often times is considered most difficult among students in retailing math. Wallace, Walker, Braseby, and Sweet (2014) stated that "the flipped classroom and TBL create space for learning, where students adopt the role of cognitive apprentice to practice thinking like an expert within the field by actively applying their knowledge and skills to increasingly challenging problems" (p269). The flipped classroom and TBL combined model may offer a more student-centered, active-learning environment which eventually help students learn not only the discipline-specific knowledge but also essential social skills such as team work and collaboration skills. Further research is also called for to evaluate the effect of TBL on long-term knowledge retention among college students.

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Appendix 1. Team-based learning peer evaluation

Your group #:

Your name:

Given the efforts and work done by your group members to complete the final forecasting project, evaluate each group member **excluding you** by distributing 100% across the group members.

Rules:

Do not evaluate yourself.

Total points to distribute: always = 100%

Name	%
Total	100%

Evaluation (*IPI = Individual Participation Index)

	1	2	3	4	5	Total	*IPI %
AAA	30%	35%	20%	40%		125%	125/170 = 63.53%
BBB	20%	25%		30%	45%	120%	120/170 = 71%
CCC	40%	25%	60%		45%	170%	170/170 = 100%
DDD	10%		15%	15%	5%	45%	45/170 = 26.47%
EEE		15%	15%	15%	5%	50%	50/170 = 29.41%
Total	100%	100%	100%	100%	100%		