USING A GROUP COOPERATIVE LEARNING APPROACH IN TEACHING STATISTICS

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Cooperative learning is a topic that is frequently mentioned in improving education, regardless of the discipline or level of instruction A cooperative learning is an activity involving small groups of learners who work together as a team to solve a problem, complete a task, or to accomplish a common goal. Different strategies have been developed to energize and enhance the teaching and learning of statistics. Many of today's university undergraduate curricula include the theme of increasing the quality of teaching with emphasis on pedagogical elements, such as active learning, in the undergraduate statistics class. In this study we will evaluate the effectiveness of cooperative instructional method in improving student learning of statistical concepts. We will also discuss the different challenges in implementing this method.

INTRODUCTION

One of the challenges of large classes is a strategy to create active learning environment to prove whether the method is successful in improving the learning of student. Most instructors of large classes resort to the standard lecture format. Studies have indicated that the lecture occupies 80% to 95% of the class time in these classes (Benjamin 1991). The aural-oriented and perhaps print-oriented learner will do well in this type of format, but a student with one of the other learning styles probably will not do as well at processing and retaining the information (Higbee et al., 1991). According to the paper of Benjamin (1991), he believes that instructors of large classes often resort to a lecture format because it is easier, and it is safer. There is less that can go wrong when doing a lecture. However, he encourages instructors of these classes to try some active learning techniques. Dietz (1993) found that cooperative learning activity on methods of selecting sample resulted in better understanding of these methods.

This study discussed an alternative method known as cooperative learning approach in teaching by integrating learning activities in class to encourage student interaction in a traditional lecture environment. Cooperative learning is a topic that is frequently mentioned in improving education, regardless of the discipline or level of instruction. A cooperative learning is an activity involving small group of learners who work together as a team to solve a problem, complete a task, or to accomplish a common goal.

As this method was implemented for the first time, in this study, we described the experiences of using this technique in a large introductory Statistics class last summer 2017 and presents some initial outcomes on how the they are used for teaching and learning of students. The different challenges of using this method will be also be discussed.

METHOD

The study was conducted to explore how cooperative learning facilitates the student interaction and improves the learning of students in a large Statistics lecture class. At University of Manitoba we teach several sections per year of an introductory class with sections ranging in size from 175 to 275 students. This class is a three units credit and covers topics from introduction to statistics up to hypothesis testing for one population proportion. This method was implemented in one section of STAT 1000 introductory statistics class with students ranging approximately from 175 – 200 students during summer term 2017. The course is a service course of the department, which is composed mostly of, mostly freshmen students. This course is a pre-requisite to other courses, so we have a common course outline and we are not allowed to omit any topics in the syllabus. Most of the students taking this class plan to major in different areas like business, psychology, agriculture food and nutrition and science. Our class lecture met three times a week with two and half hours per class.

Actually, prior to this time, I have been using an active learning method in my classroom by implementing i>clicker questions in almost all my lectures but it was not done individually. So,

this gives me a confidence to implement cooperative learning in my class by dividing them into groups. At first, when using this learning technique, I was originally concerned whether I could cover all the course materials in the course syllabus that I covered when I used the traditional standard lecture format. But it turned out that this is not the case since all the topics have been covered and created an active learning for all the students. One of the concerns that I faced is how to divide the students into groups. I applied randomization in assigning students in forming the learning groups. We used colour coding in assigning the student's group. We used four types of colour (red, blue, green and yellow) cards to assign the grouping of students. Every card was distributed to all the students before they enter the room. Students were then to go to the row designated by the colour they were holding. The first time that I used this method for dividing students into groups, it took me more or less ten to fifteen minutes for the students to go to their proper places. These are two learning activities that were modified and implemented in the class. These learning activities used are given in Garfield, J. (1993) and Magel R. (1998). This first one was done to reinforce the basic concept of measures of central tendency and be able to discuss the advantages and disadvantages of using each measure to summarize the given data set. The second learning activity illustrates the basic concept of sampling with and without replacement and calculation of probability function of a random variable X. These two learning activities are found on the last page of the paper.

DATA ANALYSIS AND RESULTS

A survey evaluation was administered on the last week of the lecture classes to determine the students' perceptions on cooperative learning method and classroom engagement and participation. Most of the students were from different disciplines. Most of them enroll this course to fulfill their university mathematics requirement or a requirement for their major. The students in this course are just taking the course because they must, not because they are interested in learning the subject. The survey evaluation used in the study was developed by McLeish (2009), which was modified and validated. The results of the survey are shown in Table 1.

First using a survey questionnaire, we assessed the attitudes of the students. It was shown in Table 1 that the mean perception rating $\overline{x} = 4.42, SD = 1.02$, which is 66.5 % of the students agreed or strongly agreed that are willing to participate in the learning activities. Many reports document the effectiveness of cooperative learning method like the paper of Johnson, D.W. and Johnson R.T. (1999). It was shown from the result of the survey that cooperative learning fosters creative thinking such that students in group generated new ideas, strategies and solutions which are more powerful than those generated in individual learning.

There are four items in the survey that registered a high mean perception. These include items on willingness of students to participate in cooperative learning activities with a mean rating of $\overline{x} = 4.42, SD = 1.02$, use of cooperative learning in helping students to integrate and socialize with other students with mean rating of $\overline{x} = 4.39, SD = 1.12$, use of this method to enhance participation with mean rating of $\overline{x} = 4.35, SD = 1.12$ and cooperative learning enhances good learning working relationships among students with a mean rating of $\overline{x} = 4.21, SD = 1.06$.

Among the twelve items given in the survey, the students responded to this item 11 the least with a mean rating of $\overline{x} = 3.46, SD = 1.78$. This pertains to assessing the students whether their work is better or less organized when they work together. In general, the overall result suggests the students gave positive perspective of cooperative learning method on the context of teaching and learning. Moreover, students indicated on the class evaluation form at the end of the summer term that they enjoyed and liked doing the cooperative learning exercises activities. Other students suggested to prefer to choose their own group. The students in the class appeared to be actively engaged in doing both the cooperative learning activities. Each group had an extensive discussion in class.

The performance of the students was assessed by three components, clicker score that is 10%, midterm test, 35% and final exam is 50% of their final grade. In as much as the topics covered in these two learning activities were based on materials covered in the midterm test, I tried to compare the performance of students in this class with students' performance in the class that I taught during the previous year summer class. The midterm tests given in both classes were not the

same, although they did cover the same topic materials and tried my best to maintain the same level of difficulty of the test.

Table 1. Students' attitudes on using cooperative learning method

No.	Item	Mean	SD
1	I willingly participate in cooperative learning activities.	4.42	1.02
2	When I work with other students I achieve more than I work alone.	3.96	0.75
3	Cooperative learning can improve my attitude towards work.	3.92	0.94
4	Cooperative learning helps me to socialize more.	4.39	1.12
5	Cooperative learning enhances good learning good learning relationships among students.	4.21	1.06
6	Cooperative learning enhances class participation.	4.35	1.12
7	Creativity is facilitated in the group setting.	3.85	0.93
8	Group activities make the learning experience easier.	4.07	1.11
9	I learn to work with students who are different form me.	4.17	1.09
10	I enjoy the material more when I work with other students.	3.82	0.97
11	My work is better organized when I am in a group.	3.46	1.78
12	I prefer that my teachers use more group activities/assignments.	3.85	0.79

The findings in Table 2 indicated that on the average, the students' scores improved when the cooperative learning method was used in the classroom. The students taught with cooperative learning method registered a mean score of $\bar{x} = 83.91, SD = 6.8$ while the other class using the traditional lecture method registered a mean score of $\bar{x} = 75.10, SD = 4.51$. The test statistics registered a calculated *t-test* statistic $t = 14.57, df = 373$ with *p-value* < 0.005. Similarly, we also analyzed the final exams of the students and it was shown from the Table 2 that the mean scores of students using the cooperative learning method is higher than those students who are subjected to the traditional lecture method. This suggests a significant difference in the mean performance scores between the two summer classes. This agrees with s K-12 studies on cooperative learning that reveled many positive advantages over teaching using a more traditional method (Johnson, Maruyama, Johnson, Nelson & Skon 1981) and Slavin (1983).

Table 2. Comparison of performance of students using the two methods

A. Midterm Test	Mean $\bar{x}$	n	SD	t-value	p-value
Traditional method	75.10	175	4.51	14.5710 $df = 373$	< 0.005*
Cooperative learning method	83.91	200	6.8		
B. Final Exam					
Traditional method	65.10	168	7.5	10.2125 $df = 361$	< 0.005*
Cooperative learning method	72.58	195	6.7		

CONCLUSION

The results of this survey seem to demonstrate that students enjoyed the different learning activities implemented in a large lecture class. Although, it was just experimented for the first time in the summer term class, it gives a positive impact on student's perceptions and attitudes, and most of all; it increased student's engagement in the large class lecture environment. The results of the study have shown that in general, these learning activities are great teaching tools that can be incorporated into a large lecture class to increase interactions among students. However, these results may not be conclusive since it was just the first time that was applied in large lecture class. We need to follow up with other research studies to assess and validate the effectiveness and impact of the method on the learning of students.

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APPENDIX
Learning Activity 1

STAT 1000
Name and Student No.: _____   Group Colour; _____

Measures of Central Tendency
Each group was given a different data sets to explore like calorie content of fast foods, scores of students in the midterm test last fall 2017 and weights of students in section A02. In this activity, the students will use these data sets to construct some simple basic plots. The following instructions are given below:
1. In your group, discuss each of the three measures of centre you have read in Unit 1 of the course materials. Make sure that everyone understands what each measure is and how it is calculated.
2. Discuss the advantages and disadvantages of using each of the three measures to summarize a data set.
3. For each of the distributed data sets, determine which measure of center would be the most appropriate as a single summary. Explain briefly why.
4. Hand in one written summary of your discussion. Be sure to include a description of each measure and how it is calculated, advantages and disadvantages of each measure. Also include a discussion of which measure of center is the most suitable to use in presenting the data set and why.

Learning Activity 2

STAT 1000
Name and Student No.: _____   Group Colour: _____

M&M's Candies Activity
Each group was given a small bag containing a mixture of three colours of M&M's candies (red, blue and yellow). This activity illustrates the basic concept of sampling with and without replacement and calculation of probability function of a random variable *X*.   The following instructions are given below:

1. Count the total number of M&M's in the bag.
- Number of red: _____
- Number of yellow: _____
- Number of blue: _____

Suppose a random sample of size three (3) M and M's are drawn from the bag one at a time *without replacement method:*
(a) Write down the sample space.
(b) Let *X* = the number of red M&M's candies are drawn. What values could *X* assume?
(c) Find the probability function for *X*.
(d) Find the *E(X)*. Write a brief interpretation of this value.
(e) Find the standard deviation of *X*.
(f) Illustrate your results using a graph the probability distribution of *X*.
(g) Discuss briefly your answers with your other members of the team before answering the second question.

2. Suppose that a random sample of size three (3) M&M's candies are drawn from the box one at a time with the *use of replacement method:*
Let X be the number of yellow M and M's drawn.

(a) Find the probability function of *X*.
(b) Find the *E(X)*. Write a brief interpretation of this value.
(c) Find the standard deviation of *X*.
(d) Illustrate your results using a histogram of the probability distribution of *X*.
(e) Discuss briefly your answers with your other members of the group your results.