A Comparative Assessment of Collaborative vs. Individual Learning

Chaya R. Jain, Virginia State University and Tristan T. Utschig, Georgia Institute of Technology

Abstract: *The purpose of this research study is to test the theory that suggests group collaboration as a positive practice of learning. As the initial segment (pilot study) of a longitudinal causal-comparative research study, we investigate the cause and effect relationship using two similar groups of students at a historically Black College and University (HBCU). The study focuses a comparison of the impacts of collaborative vs. individual learning on students' academic achievement using the research question "Does collaborative learning impact students' academic performance"? The methodology involves assignment of two similar student-groups as control and experimental (treatment) group using two sections of a liberal arts course during the fall 2014 and spring 2015 semesters. This analysis represents participation and observations involving 130 students. Our findings indicate the control-group students' displayed slightly better academic achievement than the experimental group. We present inferences based on the data and observations, and discuss opportunities for further research.*

Introduction

Three key areas of contemporary empirical research focus measurement of the effects of collaborative learning on the context of the learning situation, interactions, and processes and effects (Amigues, 1987, Pea 1993, Roschelle, 1992). This research study identifies more closely with the "effects" than any particular area impacting the effect. In other words, we examine the outcome of collaboration than the collaborative process itself with respect to task performance comparing a control and an experimental group. It measures the academic achievements of two groups' performance within the traditional face-to-face classroom setting; however, with one group receiving the intervention of collaborative activities.

Literature Review

Psychologists and contemporary pedagogy theorists (Bruner 1961, Dewey 1915, Piaget 1950, Vygotsky 1978) have articulated that as a contextualized action, learning is an active process of *constructing* knowledge than simply acquiring it. Further advancing the theory, contemporary researchers (Apple, Morgan & Hintze 2013, Bruffee, 2009) contend that the opportunity to engage with others; i.e., collaborative learning, allows students to better engage in skills of writing, critical thinking and revision, which helps foster self-growth. Collaborative learning refers to the "mutual engagement of participants in a coordinated effort to solve a problem together" (Lai 2011). Roschelle & Teasley (1995) define collaboration as *"a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem*" (p. 70). It should be noted that collaborative learning is different from cooperative learning. Collaboration involves participants working together on the same task than parallel or separate portions of the task, as is the case with cooperative learning. Collaborative learning proponents advocate that active exchange of ideas within small groups increases interest among the participants and promotes critical thinking (Lai 2011). Collaborative pedagogy theorists Bruffee (2009) and Trimbur (2009) go as far as to assert that the traditional concept of individual learning may be counterproductive to learners' critical thinking and writing, two essential components to academic achievement. However, to produce effective collaboration we must consider the quality of interaction, especially the degree of interactivity and negotiability, which can be very challenging. By its very nature, collaboration conceals individual contributions; thus assessment becomes difficult for superior- and low-achievers alike. Dillenbourg (1999) cautions about the complexity of learner dynamics, group composition, and task characteristics, all of which play a critical role in social learning.

Research Question and Hypothetical Assumptions

Testing social learning theory which suggests group collaboration as a positive practice of learning, this empirical research study explores the question: "Does collaborative learning result in students achieving higher academic performance?"

Hø: Collaborative learning does not result in higher academic achievement among students (Difference in achievement = 0).

Ha: Collaborative learning results in higher academic achievement among students (Difference in achievement ≠ 0).

Research Design and Methodology

This longitudinal causal-comparative research study investigates the cause and effect relationship using group versus individual learning activities among students. The approach involves learning outcomes for two sets of undergraduate students each semester per class; one as the experimental group, the other as a control group. For the experimental group, the intervention involves collaboration to solve a problem. The participants were divided into seven fixed groups with five students in each group. On a rotational basis, each group-member was assigned roles of captain, planner, note-taker, spokesperson and timekeeper. All seven groups were given a single problem to resolve. The control group's students learning method involved traditional individual activities addressing the same problems tackled by the experimental groups, but no group activities were performed by the control group.

Population and Sample

The target population of 130 students for this study comprises of undergraduate students in two sections of POLI 102 State and Local Governments course at a Historically Black College/University (HBCU). A required entry-level course for political science majors, the course also serves as a general-education elective for all undergraduates.

The following summarizes the overall characteristics of the sample population:

- Two classes of 31 students each in fall 2014 and 34 students each in two spring 2015 courses.
- Total Sample Population = 130 students during the Academic Year 2014-15.
- Experiment Group: 65 students receiving instruction through group activities.
- Control (Comparative) Group: 65 Students receiving identical instruction, but without any group activity (or, as individual activities exclusively).
- Racial Make-up: a homogenous racial group; all except one of the overall 130 students is African-American.
- Academic Level: predominantly freshmen (see Table 1).
- Gender Make-up: predominance of female students at 65% overall (see Table 2).
- Overall, 74% students are first-generation college goers.

Sample Treatment and Approach

Participant students' permission was secured through advance informed consent approved by the institutional review board. Test scores were recorded using a code for each student to maintain anonymity for the study analysis relating to academic achievement.

Experimental Group Setup:

- Students in both semesters' classes were divided into groups of five individuals per group.
- Group formation was achieved using the random assignment technique, which was done based on students calling a number from 1 to 7.
- The fall 2014 group was administered four separate group collaboration activities.
- The spring 2015 semester's experimental group was administered two separate group collaboration activities.

Except for the group activity, both the control and experimental groups in each semester were administered the following identical methods of instruction and respective weights:

(1) *Advance online i*nstruction and posting of materials on syllabus for preview and comprehension of content-related supplemental materials including videos, web-links, etc.;

(2) In-class brief lectures with supplemental visual aids and materials from various Internet websites including PowerPoint summary of course content and chapters;

(3) Class discussions and participation;

(4) Homework assignments;

(5) Traditio*nal tests and exams.*

Experimental Group's face-to-face, in-class group learning activity method:

(1) Advance posting of the planned group activities on the syllabus;

(2) To ensure participation, advance reminders up to the day of each assignment.

(3) Distribution of group tasks on the scheduled day during the class session;

(4) Upon completion of the assignment, peer assessment of group activity using the strengths, improvement and insight (SII) method. Students were provided the SII form (courtesy Pacific Crest) to log their assessments; and,

(5) Students' mutual peer reviews and assessment of performance.

Control (Comparative) Group's face-to-face, in-class learning activity method:

This group was given identical course instruction as the experimental group but without any collaborative interaction or activities.

Study Operationalization

- Independent Variable = Mode of learning (collaborative vs. traditional individual learning)
- Measurement: Four group activities during the fall 2014 semester and two group activities during the spring 2015 semester
- Dependent Variable = Academic achievement grades, measured as follows:

  A [b_1] = achievement grade of 90% and above

  B [b_2] = achievement grade of 80-89%

  C [b_3] = achievement grade of 70-79%

D [b_4] = achievement grade of 60-69%

F [b_5] = achievement grade below 60%

- Controlled Variables = duration of instruction, timeframe of instruction (same semester), and class size.
- Variables not controlled (because homogeneity of the population lends itself to control for the influence of the three variables stated above): age, race, gender.

Data Collection

Achievement grades (percentage) were recorded for each of the seven groups using codes to maintain student anonymity. For Fall 2014, four group activities' data was collected. For spring 2015, four group activities were planned; however, only two group activities were administered because of cancellation of classes due to inclement weather. The academic achievements represent a cumulative total of all graded activities including tests and exams.

Data Analysis

Two methods were used to analyze determine the comparison of the academic achievement between the experimental and control groups:

1. Simple descriptive statistics: means, frequency distributions, etc.
2. A t-test to determine the significance of difference between the two groups' means, appropriate for the post-test-only randomized experimental design, as follows:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}\left[\frac{n_1+n_2}{n_1 n_2}\right]}}$$

Where: $\overline{X}_1$ **is the mean for Group 1 (Experiment Group)**

$\overline{X}_2$ **is the mean for Group 2 (Control Group)**

(a) ***Descriptive Statistics***

Table 1 Student Distribution by Semester

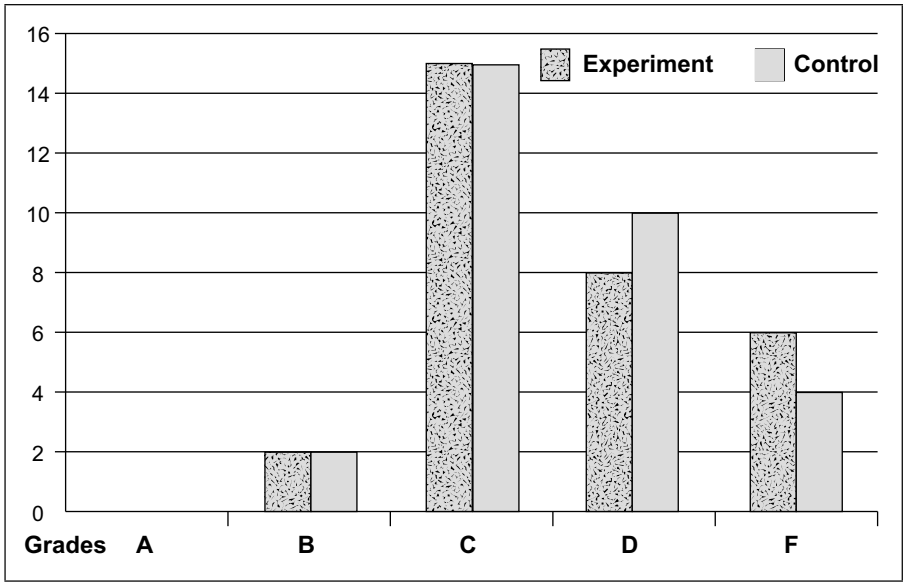
Academic Rank	FALL 2014		SPRING 2015	
	Section 1	Section 2	Section 1	Section 2
Freshmen	31 (100%)	27 (87%)	21	20
Sophomore	0	3	7	6
Junior	0	0	3	4
Senior	0	1	3	4
TOTAL	**31**	**31**	**34**	**34**

Table 2 Student Distribution by Gender

Student Gender	FALL 2014		SPRING 2015	
	Sec 1	Sec 2	Sec 1	Sec 2
Male	13	11	10	13
Female	18	20	24	21

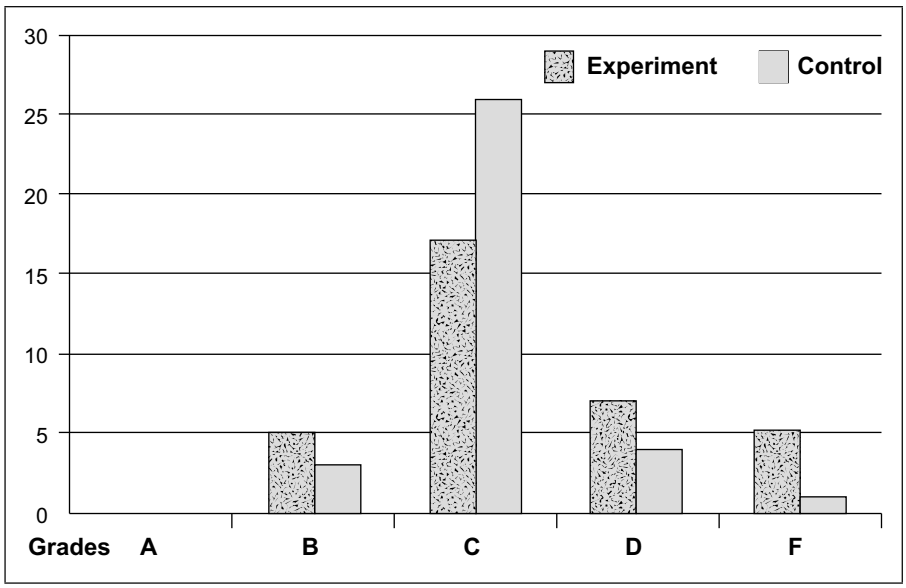
Graph 1 Fall 2014 Distribution of Academic Grades (N=62)

Note: Each of the comparative groups represents 31 students



Graph 2 Spring 2015 Distribution of Academic Grades (N=68)

Note: Each of the comparative groups represents 34 students



(b) ***Test Statistics – The T-test Analysis***

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}\left[\frac{n_1+n_2}{n_1 n_2}\right]}}$$

Therefore,

Fall 2014:

$$t = \frac{65-67}{\sqrt{\frac{235.32}{31} + \frac{140.66}{31}}}$$

$$t = -0.16$$

Spring 2015:

$$t = \frac{69-74}{\sqrt{\frac{296.87}{34} + \frac{224.10}{34}}}$$

$$t = -0.39$$

Table 3 T-Test Statistics

	Fall 2014		Spring 2015	
	Experiment Group	**Control Group**	**Experiment Group**	**Control Group**
N	31	31	34	34
Mean	65	67	69	74
Std Dev.	15.34	11.86	17.23	14.97
DF	62 – 2 = 60		68 – 2 = 66	
t-value	-0.16		-0.39	

Table 4 T-Test Statistics Inferences for a Two-Tailed Test

Fall 2014	Spring 2015
Degrees of freedom equals the total group size (62) minus 2, or 60	Degrees of freedom equals the total group size (68) minus 2, or 66
Entering a t table with 60 degrees of freedom for alpha = .05, the tabled value is 2.0	Entering a t table with 66 degrees of freedom for alpha = .05, the tabled value is 1.996
For alpha (or the significance level) = .01, the tabled value is 2.664	For alpha = .01, the tabled value is 2.624
Since calculated value is smaller than the T Distribution Critical Values Table at alpha = .01, we fail to reject the null hypothesis. Thus, it is unlikely that collaborative learning among the experimental group resulted in higher academic achievement.	Since calculated value is smaller than the T- Distribution Critical Values Table at alpha = .01, we fail to reject the null hypothesis. Once again, this suggests that collaborative learning among the experimental group resulted in higher academic achievement.
The alternative hypothesis is rejected.	The alternative hypothesis is rejected.

Findings

The frequency distribution analyses (Graphs 1 and 2) for both semesters' show the control group students achieving slightly better academic success rate than the experiment group. The t-test statistical findings demonstrate the p-value being smaller than the significance level (α), which suggests that the observed data are inconsistent with the assumption that the experimental group would perform better than the control group. Therefore, we fail to reject the null hypothesis. Findings for both semesters fail to show collaboration having a positive impact on students' academic performance. In fact, the control group's students who received instruction without any group collaboration activities demonstrate a slightly higher academic achievement than those in the experimental group.

Discussion

As a pilot study, the initial stage of this experiment surfaced numerous key observations and constraints. These include: participant absenteeism; student reluctance to contribute to group discussion; expectation of additional reward for participation; personality conflicts within participant groups; the "hitchhiker" problem, and; participants' propensity to avoid negative assessment of peers. Results for academic achievement along with constraints and observations indicated here, merit reconsideration of the intervention methodology such that future implementation might better ensure participants' individual accountability within the groups. Within the two major classes of group activity, collaboration and cooperation, the latter supports individual accountability to a greater degree because it requires distribution of tasks among a group for achievement of a common goal.

Conclusions

The purpose of this study was to determine whether collaboration helps students achieve higher academic performance. Two identical courses with similar demographics were employed as the experimental and control group. In a direct comparison study, four classes were used over two consecutive semesters of the academic year. Two classes were taught in a traditional manner while the other two were taught using collaborative activity. The findings fail to demonstrate a positive impact of collaborative learning on students' academic performance. In fact, students in traditional instruction classes scored slightly higher on the measured performance tasks than those using collaboration as a learning technique. As an initial phase of a longitudinal study however, our observations and findings offer valuable information for reassessment of the group learning activity design as well as future opportunities for further research.

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A Comparative Assessment of Collaborative vs. Individual Learning: Interactive Group Exercise

Presenters:

Chaya R. Jain, Virginia State University & Tristan T. Utschig, Georgia Institute of Technology

Scenario:

You are teaching two sections of a course with 35 freshmen in each class (if needed, please see the full paper in on the previous pages). Your purpose is to test whether group activity helps improve students' academic performance.

You have two intervention choices in testing your research question: (1) collaboration, where all five students in a group attempt to resolve a given problem, OR, (2) cooperation, where students divide the tasks to resolve a given problem. Use the following in providing your answers:

Implementation Plan:

1. As a group, discuss which intervention, collaboration or cooperation, best helps achieve your purpose and why (15 minutes).
2. Describe how you would set up your group activity including the Assessment Methodology (15 minutes).

Report your findings to the session attendees (5 minutes)

Questions/Answers: (10 minutes)