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Share, Show, and Tell: Group Discussion or Simulations Versus Lecture Teaching Strategies in a Research Methods Course

Judith A. Linneman[1]

Abstract

Impacts of incorporating active learning pedagogies into a lecture-based course were examined among 266 students across nine research methods course sections taught by one instructor at a large public university. Pedagogies evaluated include lecture only, lecture with small group discussions, and lecture with simulations. Although lecture-simulations sections outperformed lecture-only sections on one outcome measure, few performance differences appeared between lecture-only and alternative groups. Even when controlling eight variables potentially affecting performance, active learning components provided little measurable learning benefit. Student appraisals of instructor effectiveness were generally favorable, and students preferred the lecture-only format to the lecture-discussion format. Despite calls to reduce reliance on lecturing, these data suggest introducing active learning into lecture-based courses may not consistently enhance achievement. Perhaps discussions and simulations were too few or too short in duration to yield significant learning advantages. Course content and instructor style and experience likely confound effects of teaching methodology on achievement.

Keywords

active learning, research methods, simulation, student engagement, student learning

Calls for major changes in teaching practices in higher education have been made for decades. Yet as late as 2011, Arum and Roksa (2011) presented evidence that an undergraduate education in the United States provided many students with only minimal gains in critical thinking, complex reasoning, and writing skills. While most critiques of traditional lecture-based teaching methodologies have focused on STEM fields outside the social sciences, calls for increased use of laboratory experiences and demonstrations in sociology courses were made more than 20 years ago (Cover 1995).

The literature is rife with studies touting benefits of alternative teaching strategies for college classrooms. Most feature some variation of active learning (Michael and Modell 2003), which occurs along a continuum of levels of student engagement with instructors, peers, and course material.

On one extreme, also known as the sage on stage model, teachers do little more than tell students what they are expected to learn, answer questions, and assign readings. Assessment consists of a process reversal, with students transmitting information back to teachers on assignments and examinations often requiring little more than recognition

[1]Texas A&M University, College Station, TX, USA

Corresponding Author:
Judith A. Linneman, Department of Sociology, Texas A&M University, Mail Stop 4351, College Station, TX 77843-4351, USA.
Email: j-linneman@tamu.edu

of memorized material. Students play an almost entirely passive role in this teacher-centered classroom (Pederson and Liu 2003). Students perceive information only through hearing or reading and must process it themselves.

Critics of passive learning contend that such limited cognitive engagement leads to bored students adept at securing grades by memorizing information they barely understand, struggle to apply, and cannot analyze or critique (Bloom 1956). With only a tenuous grasp of its importance, they may undervalue their learning, discouraging retention. The physical geography of many classrooms still assumes an omniscient teacher transferring knowledge to blank slate or empty vessel students seated in immovable desks oriented toward the expert (Freire 1986). Others defend a continued place for lecturing in college classrooms, such as McDaniel (2010), who argues that the ability to listen to and comprehend a speaker is an important skill on which civic life and responsibility are based.

On the opposite extreme, learners in active learning environments engage with their instructor, one another, the material, the physical world, and technology in multiple ways and employ various cognitive processes in a student-centered classroom (Collins and O'Brien 2011; Meyers and Jones 1993). Evidence from learning science, cognitive science, and educational psychology suggests these environments are more conducive to learning than teacher-centered classrooms (Bransford, Brown, and Cocking 1999; Michael 2006).

Active learning methodologies deepen understanding by expanding the ways learners build knowledge and the levels at which it is processed. From a constructivist perspective, students are mental model builders erecting their own unique scaffolds on which to develop and elaborate their understanding of new information based on existing knowledge and experience (Bruner 1960; Dewey 1938; Piaget 1973). Because simulations mimic a process by means of a simpler analog and demonstrations often use physical objects or props to present evidence of a truth, both teaching techniques should enhance learning (Astrachan 1998).

Most simulation and demonstration pedagogies examined in this research feature characteristics of both. For example, in the VIVID (Variables In Vials Illustrating Data) activity, each student drew a role card from a stack, then inserted a color-coded marble and bead into a plastic vial according to data on the card, placing the vial into one of four quadrants on a rack. The process simulated a survey and construction of a cross-tabulation table showing a relationship between two variables. Then the vials were rearranged to add a control variable, demonstrating (i.e., establishing the truth) that the original relationship was spurious. Despite the overlap, most such activities more closely resemble simulations, the term by which they generally will be identified hereafter.

Discussion-based courses stimulate learning by exposing students to the perspectives of classmates and require them to develop higher level cognitive skills as they use evidence to articulate their views, frame arguments, summarize and/or defend their positions, and perhaps compromise.

Resistance to active learning pedagogies arises from students opposed to playing more than a passive role in their education and from their instructors (Shimazoe and Aldrich 2010). While much is known about deep learning, knowledge transfer and retention, and the development of critical thinking and problem-solving skills, most college teachers merely employ the teaching techniques used by their own professors (Halpern and Hakel 2002). Many may have limited experience outside lecture-based classrooms, making them unlikely to abruptly abandon lecturing in favor of active learning strategies. They might be willing to introduce these methods on a modest scale, however. Would such incremental changes yield measurable learning advantages?

RESEARCH AIMS

One aim of this research is to determine whether the introduction of a single active learning component into a lecture-based course is beneficial. A second aim is to determine whether group discussions or the use of simulations produces a greater improvement over lectures. Much of the research on the efficacy of active learning versus lecture teaching styles comes from fields outside the social sciences (Freeman et al. 2014). A final aim is to augment knowledge about the effectiveness of active learning strategies in the liberal arts classroom.

Despite calls for instructors to study their teaching effectiveness with the same rigor used in their substantive fields (Boyer 1990), pedagogical studies often are limited by small numbers of cases and lack control groups and pretests. Many focus primarily on outcomes other than academic performance, such as student appraisals of teaching or self-reporting of impact on learning. Those including multiple sections of the same course rarely are taught by the same instructor covering the same material and using the same assessments. (For a defense of such studies, see Dunn 2008.) This research attempts to overcome these limitations.

REVIEW OF THE LITERATURE

Collaborative Learning/Small Group Discussion

Comparisons of small group discussions to lecture-based courses in various fields have typically shown small group discussions result in greater quantitative conceptual learning than lecture alone. (For a recent meta-analysis of such studies in mathematics, see Capar and Tarim 2015.) Within research on the effects of collaborative learning groups in sociology courses, Caulfield and Persell (2006) present evidence that group work enhanced student performance when compared to controls, while Huggins and Stamatel (2015) found no such effect. Garside (1996) found higher overall test scores in lecture-based sections of a communications class, but small group discussion sections scored significantly better on higher level thinking skills.

Simulations and Demonstrations

Studies of the effectiveness of simulation use show mixed results (see Ishiyama 2013). Some found simulations provide positive impacts on factors other than content mastery (Franklin and Lee 2014; Latshaw 2015; McCoy 2017). Investigations of in-class simulations in social science courses have also found significant student gains in quantitative measures of academic performance when compared to lecture-based controls (Baranowski 2006; Frederking 2005; Lay and Smarick 2006). Krain and Lantis (2006) and Raymond (2010), however, found simulation treatment groups and controls had equivalent performance outcomes. Bernstein and Meizlish (2003) found simulation and traditionally taught control groups performed equally well on a posttest administered immediately after the simulation, but the simulation group outperformed the control group three years later.

Although students tend to rate in-class demonstrations positively (Di Stefano 1996), results of studies on their impacts have also been mixed. Some revealed that classroom demonstrations provide significant gains in academic performance when compared to lecture-only controls (Balch 2014; Owen and Siakaluk 2011; Sharma et al. 2010; Sokoloft and Thornton 1997). Webster and Muir (1995) found a classroom demonstration provided significant performance gains for students tested on simple material, but those in a lecture-based control performed better on complex material. Miller et al. (2013) showed that students received the greatest learning benefit from demonstrations when asked to predict their outcomes (see Crouch et al. 2004).

Comparison of Small Group Discussion and Simulation or Demonstration

Systematic investigations of the comparative impacts of small group discussions and exposure to simulations or demonstrations are rare. (For a review of early work in this area, see Garrett and Roberts 1982.) A comparison of the academic performance of students exposed to in-class physics demonstrations to those working in small groups found that female students performed better when exposed to a demonstration while males performed equally well in the two pedagogy groups (Thijs and Bosch 1995). Powner and Allendoerfer (2008) found political science students in a simulation group outperformed their counterparts in a lecture-based control on a knowledge-based posttest but did not score as highly as those in a section featuring small group discussions.

Teaching and Learning in Research Methods and Statistics Courses

Nind, Kilburn, and Luff (2015) call for more research on achievement in research methods courses. Students enrolled in methods and statistics courses may face unique challenges, such as math anxiety; exhibit high variability in preparedness (Harrington and Schibik 2004; Markle 2017; Wilson 2013); and be likely to hold misconceptions impeding their progress (Cook and Fukawa-Connelly 2016; Derry et al. 2000). Harrington and Schibik (2004) argue that active learning techniques are particularly important in statistics courses, where students with diverse learning styles may struggle to conceptualize statistical processes, and thus benefit from classroom experiences modeling data quantitatively and visually (see also Lovekamp, Soboroff, and Gillespie 2017).

Several studies have demonstrated that introducing active learning elements into research methods and statistics courses can improve student performance (Monson 2017; Ruggieri 2016; Wilson 2013). Although Garfield and Ben-Zvi (2007) question the generalizability of comparative studies on teaching and learning statistics, Autin, Bateiha, and Marchionda (2013) found no significant differences in achievement when comparing a lecture-based statistics course section to one featuring small group discussions.

EXPECTED OUTCOMES

Because the least active learning occurred in the lecture course sections, this pedagogy group is expected to exhibit the lowest overall achievement. Since simulations engage student interest and attention, increase visual or other stimulation, cause students to think about course material in new ways, and/or help them grasp abstract concepts through their understanding of familiar ones, these sections are expected to show greater overall achievement than lecture sections. Small group discussion sections are expected to outperform both other groups due to the higher level thinking skills developed in the discussion process and because group discussions occurred more frequently than simulations (approximately once per class period and once per one and one half weeks, respectively).

Due to the association of active learning with deeper cognitive processing of information, both the discussion/lecture and simulation groups are expected to exhibit higher levels of deep learning than the lecture-only group, particularly on test questions specifically drawing on material addressed in discussions (discussion content question performance) or simulations (simulation content question performance).

METHOD

Data were collected during academic years 2014–2015 and 2015–2016 from 266 undergraduates enrolled in nine sections of a required, majors-only, introductory social research methods course in sociology at a large public university in the United States. Most participants were third-year or early fourth-year students. Some sections were taught during fall or spring (15 weeks) and others in summer (5 weeks). The author, with extensive experience teaching the course, taught all sections in mid- to late morning in the same classroom covering identical material and using identical tests and other assessments. Mean enrollment was approximately 32, and the participation rate was approximately 87 percent. The university's Institutional Review Board approved and monitored the research to ensure confidentiality of student education records and voluntary participation without coercion. Persons unaffiliated with the course and the research managed recruitment, collected signed informed consent forms in the absence of the instructor, and stored the forms until final course grades were submitted.

In all course sections, the instructor presented course content verbally in an animated and enthusiastic style, using PowerPoint slides to display an outline of major points. The instructor posed questions to the class frequently to encourage participation, often asked for student questions, and presented many examples. Students worked in three-person teams to conduct research projects outside the classroom and completed individual electronic data analysis assignments. Attendance was recorded daily but not graded.

Alternative Pedagogies

The nine sections were divided into three pedagogy groups, which used the following three teaching methodologies: lecture only (LO), lecture with small group discussion (LD), and lecture with simulations (LS). LO sections ($N = 80$) employed a traditional teaching style in which all course content was presented verbally as previously described.

In the LD sections ($N = 90$), students were required to sit near their two teammates. Approximately once per class period, a discussion question was posed. Students first reflected on the question as individuals, then discussed it with teammates (a variation of think-pair-share). After the discussion period, a number indicating 1 of 12 teams was called. A spokesperson from the selected team then summarized his or her team's response. After doing so, he or she provided the number of the next team to report to the class, which identified a third team. This process continued until the question was adequately addressed. Instructor response to team contributions varied, depending on whether the discussion question was intended to elicit a correct response or encourage students to share their views on a subjective issue.

In the LS sections ($N = 96$), lecture was supplemented with eight classroom simulations focusing on key course concepts. Examples include a hypothetical Olympic-style event (covering level of measurement), using cooking utensils to simulate preparation of a pot of chili (covering basic sampling), a tank filled with dried beans (covering sampling distributions), and a data display rack on which students hang cylinders under a number representing their response to a query (covering frequency tables and statistics). Seven of the eight simulations featured student involvement through varying degrees of physical activity or provision of personal data, written ratings, or written predictions of outcome.

Measurement and Student Assessment

Ungraded pretests were used to gauge preexisting knowledge of key content. Student assessment also included administration of three objective examinations. Test and pretest questions were sufficiently challenging to prevent a ceiling effect limiting improvement. Pretests and examinations measured depth of learning by including equal numbers of questions measuring shallow and deep learning. Questions measuring shallow learning covered material students could memorize, such as facts or definitions. For example, asking students to identify a definition of sampling error or how many standard errors are on either side of a sample mean in a 95 percent confidence interval measured shallow learning. Deep learning questions required students to apply course content, such as calculating a standard error and constructing and interpreting a 95 percent confidence interval for a set of data.

Mastery of material covered in group discussions was measured using only those test questions specifically addressing such content (discussion content test questions). Mastery of material covered in simulations was measured using only test questions specifically addressing such material (simulation content test questions). Student demographic information was collected at the conclusion of each course. Student evaluation of teaching utilized standard Likert-style items used across the university.

Statistical Analysis

Demographic and other differences between students in the pedagogy groups were examined using ANOVA or chi-square tests. Independent samples *t* tests were used to identify any statistically significant differences in outcome variables between the pedagogy groups. Using ordinary least squares regression and an LO reference group, overall test scores and the subsets of test scores described previously (dependent variables) were modeled as functions of pedagogy group (independent variable) while accounting for other variables that may predict test performance, including sex, race/ethnicity, class year, credit hour enrollment, attendance, pretest score, GPA, and employment. Use of these covariates as controls contributed to the isolation of effects of pedagogy group on student performance from those of potential lurking or confounding variables. Students were not included in this analysis unless they completed the class by taking all three regular course examinations. Missing data on covariates required exclusion of only 28 cases in models with covariates (N = 238).

RESULTS

Data for selected student demographic characteristics reveal some differences between pedagogy groups (Table 1). The LS group included fewer fourth-year and more third-year students, students who attended class less frequently, and students enrolled in more credit hours than the other groups. The LS group had fewer students enrolled during summer sessions, resulting in higher credit hour enrollment.

Most differences in mean student performance on test questions were small, and few were in the expected direction (Table 1). No significant differences between pedagogy groups were found on pretest scores, pretest to posttest gain, total test score (posttest total), shallow learning test questions, deep learning test questions, discussion-content test questions, simulation-content test questions, discussion-content shallow test questions, simulation-content shallow test questions, discussion-content deep test questions, and simulation-content deep test questions. Contrary to expectations, the LO group performed surprisingly well, rarely having the lowest performance on an outcome variable. Unexpectedly, student appraisals of teaching yielded higher ratings of instructor effectiveness in the LO group than the LD group ($p =$ .03). No significant differences in rating of instructor effectiveness were found between the LO and LS groups or overall student ratings of the course.

Regression Findings

Table 2 shows results for regression models run while holding the following variables constant: sex, race/ethnicity, class year, credit hour enrollment, attendance, pretest score, GPA, and employment. A comparison of LD and LS groups to the LO reference group showed no significant differences in total test score based on all test questions (posttest total). Pedagogy group also had no significant impact on shallow or deep learning test question performance. Analysis of pedagogy group effects on discussion content and simulation content test questions also failed to produce significant differences.

Effects of pedagogy group on shallow learning for both discussion content and simulation content test questions are also shown in Table 2. As

Table 1. Summary Data for Participant Characteristics, Test Question Performance Variables, and Student Appraisals of Teaching, by Pedagogy Group.

		Pedagogy Group		
		Lecture Only (N = 80)	Lecture/Discussion (N = 90)	Lecture/Simulation (N = 96)[a]
	Variable	Percentage (chi-square significance tests)[b]		
Sex	Female	82.5	72.2	67.4
	Male	17.5	27.8	32.6
Race/ethnicity				
	African American	6.3	5.6	12.0
	Caucasian	56.2	53.3	47.8
	Hispanic/Latinx	30.0	32.2	32.6
	Other/multi/Asian[c]	7.5	8.9	7.6
Class year*				
	First/second	37.5	28.9	33.7
	Third	37.5	37.8	51.1
	Fourth	25.0	33.3	15.2
GPA[d]	<2.5	18.7	22.7	20.6
	2.5–2.99	37.5	44.3	28.3
	3.0–3.49	30.0	25.0	43.5
	3.5–4.0	13.8	8.0	7.6
Employed	No	57.5	41.1	44.6
	Yes	42.5	58.9	55.4
		Means (independent samples *t* tests, standard deviations in parentheses)		
Age (years)		20.4 (1.9)	21.1 (3.7)	20.7 (1.5)
Credit hour enrollment**		11.5 (4.3)	11.9 (4.3)	14.4 (2.0)
Attendance (percentage)**		84.3 (15.4)	86.0 (14.2)	77.3 (21.5)
Test question type (percentage correct)				
Pretest (based on 242 cases)		40.6 (11.9)	41.7 (9.6)	40.9 (11.4)
Pretest to posttest total gain (242 cases)		28.3 (12.0)	27.4 (11.2)	26.5 (12.7)
All questions (posttest total)		69.0 (12.2)	68.6 (10.4)	66.7 (11.2)
Shallow (facts/definitions)		74.2 (11.9)	73.6 (10.8)	72.1 (10.8)
Deep (applications)		63.8 (13.7)	63.7 (11.2)	61.4 (12.6)
Discussion content		67.2 (12.3)	67.5 (11.3)	65.3 (12.3)
Simulation content		61.6 (17.8)	62.9 (14.8)	62.1 (15.2)
Discussion content shallow		74.4 (13.0)	74.9 (12.3)	73.0 (12.9)
Simulation content shallow		69.5 (17.6)	72.9 (18.6)	74.6 (17.7)
Discussion content deep		60.0 (14.0)	60.0 (12.9)	57.6 (13.8)
Simulation content deep		54.4 (23.0)	53.7 (17.7)	50.7 (18.7)
Overall student rating of course[e]		4.71 (.39)	4.56 (.58)	4.54 (.60)
Student rating of instructor[f]*		4.76 (.58)	4.51 (.77)	4.57 (.82)

[a]In this pedagogy group, N for demographic variables is 92.
[b]Asterisk(s) next to a variable name indicate at least one statistically significant difference between pedagogy groups.
[c]Includes Asian due to a small number of students claiming an Asian race/ethnicity.
[d]Grade point average on a scale of A = 4.0, B = 3.0, etc.
[e]Mean on 15 Likert-type statements, 1 to 5 scale, 5 indicating most favorable. N = 224.
[f]Mean on "I believe this instructor was an effective teacher," 1 to 5 scale, 5 = strongly agree. N = 224. Mean for the lecture/discussion group was significantly lower than that for the lecture-only group.
$^*p \leq .05$. $^{**}p \leq .01$ (two-tailed tests).

Table 2. Ordinary Least Squares Coefficients (β) for Models Predicting Test Question Performance (percentage correct) among Pedagogy Groups.

	Test Question Type								
	All (posttest total)	Shallow Content	Deep Content	Discussion Content	Simulation Content	Discussion Content Shallow	Simulation Content Shallow	Discussion Content Deep	Simulation Content Deep
Pedagogy group[a]									
LD	.6	.3	.8	1.2	1.9	1.2	3.8	1.2	.1
LS	.9	.4	1.3	1.8	4.1	1.8	9.6**	1.7	−1.0
Covariates[b]									
Attendance (deciles)	1.4**	1.3**	1.4**	1.6**	1.8**	1.5**	.7	1.8**	2.8**
Pretest (deciles)	3.2**	2.9**	3.5**	3.0**	4.9**	3.0**	4.3**	3.0**	5.4**
GPA									
<2.5	−11.3**	−11.5**	−11.0**	−11.6**	−12.5**	−11.2**	−12.0**	−12.0**	−12.9**
2.5–2.99	−12.3**	−11.6**	−12.9**	−12.4**	−14.7**	−10.2**	−13.2**	−14.6**	−16.2**
3.0–3.49	−8.9**	−7.8**	−10.0**	−9.3**	−10.0**	−7.7**	−9.4*	−11.0**	−10.5*
Credit hours								−.5*	
Employed		−2.6*		−2.8*		−3.7*			
African American			−7.1**						−8.3*
Hispanic/Latinx			−4.0*						
Other/multi/Asian						5.1*	−5.8*		
Observations	238	238	238	238	238	238	238	238	238
R^2 with covariates	.342	.312	.329	.312	.297	.256	.190	.302	.273
R^2 no covariates (N = 266)	.011	.009	.011	.002	.001	.001	.019	.004	.005

[a]Reference group = lecture only. LD = lecture with discussion; LS = lecture with simulations.
[b]Reference groups = GPA >3.49, not employed, Caucasian/white.
*$p \leq .05$. **$p \leq .01$ (two-tailed tests).

expected, the LS group outperformed the LO group on shallow simulation content test questions (p = .001). The LD group did not perform significantly differently than the LO group on either the shallow discussion content or shallow simulation content test questions variable. No significant differences between the two pedagogy groups and the LO group appeared in deep discussion content and deep simulation content test question performance.

SUMMARY AND DISCUSSION

Any positive effects on student achievement produced by the introduction of discussion groups and simulations into a social research methods course were small when compared to the lecture-only control. Attendance, GPA, and pretest score predicted student performance much more powerfully than class format. Overall student performance on tests was not significantly impacted by the active learning pedagogies even when examining shallow versus deep learning. Moreover, when the focus was limited to test questions specifically drawing on material addressed in group discussions or simulations, students did not benefit significantly from the introduction of these active learning course components.

Analysis of shallow versus deep learning on test questions focusing specifically on material addressed in discussions or simulations revealed that students in the lecture/ simulation group outperformed the lecture-only group on questions measuring shallow learning specifically related to course content covered in simulations. This effect did not extend to deep learning or the lecture/discussion group. Students rated instructor effectiveness in the lecture-only class format more favorably than the lecture/discussion alternative, a finding consistent with the claim that students may resist playing more than a passive role in their education.

Despite recent attention on the importance of adding active learning components to lecture-based courses, these data failed to demonstrate consistent positive impact across various student performance outcomes. Even though the types of course content lending itself to presentation through simulations is limited and access to physical props and their portability may be problematic, these findings provide some evidence in favor of using them. Rather than interpreting these results as justification for continuing to rely solely on lecturing, they suggest a lecture-only teaching methodology in a liberal arts classroom can be as effective as lecture supplemented with active learning components, and additions such as discussion groups or simulations may or may not improve student performance.

Furthermore, idiosyncratic factors such as course content and instructor lecturing style and teaching experience also likely impact classroom dynamics and the effectiveness of various instructional techniques. Finally, perhaps one or two discussion periods per class session and eight simulations were not sufficient to produce measurable positive impacts. This study was also limited to only one course taught by one instructor at one university. Future research should expand the types of courses and active learning pedagogies examined, investigate whether knowledge gained from active learning pedagogies is more persistent over time than that from traditional teaching methods, and identify any threshold at which active learning pedagogies more consistently produce learning benefits.

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AUTHOR BIOGRAPHY

Judith A. Linneman is an instructional associate professor of sociology and director of instructional training in the Department of Sociology at Texas A&M University (TAMU). She received her PhD in sociology from Iowa State University. Her areas of research and teaching include social research methods and teaching. She received a Liberal Arts Association of Former Students Distinguished Achievement Award in College-level Teaching at TAMU in 2016. *The Rural Sociologist* and *Journal of the Community Development Society* have published her work.