CAN STUDENT PRESENTATIONS BE AN EFFECTIVE FORM OF ACTIVE LEARNING FOR THE STUDENT AUDIENCE?

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ABSTRACT
This classroom experiment investigated learning gains and preferences by students who served as an audience for both peer and instructor presentations. An interactive component, such as a game or discussion, was included in each 25- to 35-minute group presentation. Seven student group presentations were interspersed with four presentations of the same format given by the instructor. The same open-ended quiz question was used before and after each presentation to assess learning gains resulting from the interactive presentation. Student scores increased by an average of 2.06 points (out of 5) on the post-instruction quiz for topics presented by the instructor (SD = 0.86 n = 25) and an average of 1.89 points for topics presented by student groups (SD = 0.64, n = 25), but paired t-tests showed no difference in learning between these methods. These data suggest that with significant guidance and clear presentation parameters, students can learn as much from peer presenters as from interactive lessons by the instructor. Surveys at the beginning and end of the semester also assessed student interest in each topic and preferences for classroom learning formats.
Keywords: collaborative learning, group presentations, classroom activities, student perceptions, learning gains

INTRODUCTION

Faculty often devote significant class time to student presentations and wonder if the time is worth it. Measuring learning gains from the students who served as an audience for presentations by their peers was the focus of this project. Student presentations in many classrooms take place in small groups, likely because groups help improve the overall quality of presentations and take less class time for all students to participate than individual presentations. While group presentations keep some students active in front of the classroom, the majority of the class remains a passive audience.

Ideally, student presentation assignments can be designed in a way that makes them effective learning opportunities for both presenters and listeners alike. On the other hand, learning gains for the student presenters may not be sufficient reason to require that the whole class listen to each group if the student audience gains very little. If listening to student presentations is not an effective use of classroom time, instructors could set up group presentations so that only some groups or only the instructor would serve as the audience for the student presentations. These could be live or even pre-recorded videos.

The student presentation format may not lead to effective learning from the student audience for at least four reasons: (1) students paying less attention to fellow student presenters than they would to an instructor; (2) students having less interest in detailed topics selected by other students than broadly applicable topics selected by an instructor; (3) student presenters not communicating as clearly as the instructor; and (4) student presenters having a less sophisticated grasp of the context and significance of the information they researched, as well as less experience evaluating reliable information sources.

The present study compared perceived learning preferences with direct measures of learning gains. It investigated which classroom teaching formats students preferred and perceived as most effective. Additionally, the study investigated whether student interest in topics changed as a result of the lessons. Although assessing the affective domain is imprecise, the overlap between cognitive and affective domains stressed by Bloom (1964, p. 57) makes student interest important to consider.

Context and Review of Literature

Active learning formats during class periods consistently enhance student engagement and learning (Umbach and Wawrzynski, 2005; Michael, 2006), although questions remain about what forms of student engagement are most effective. Group work brings with it a long set of challenges and benefits (e.g., Livingstone and Lynch, 2000; Burdett and Hastie, 2009; Tomcho and Foels, 2012). Active learning classrooms most often take place with students explaining or exploring class concepts with each other in order to apply concepts first presented by the instructor or reading assignments (e.g., Fagen et al., 2002; Crouch and Mazur, 2011; Killian and Bastas, 2015). One form of active learning, known as '*Collaborative learning' or 'Cooperative learning'*, involves student teams creating a final product such as solving a problem (Johnson et al., 1998). In some classroom formats, students serve as the first source of information for peers when they teach concepts to each other. Learning by teaching is highly effective because the teachers have strong motivations to learn while preparing to

teach, actually teaching, and observing pupil performance (Schwartz et al., 2016). This includes the 'jigsaw' format where peer 'experts' teach within small groups (Clarke, 1994), as well as more formal presentations by students to the whole class. However, when student presentations become lectures, the distinction blurs between active learning and passive learning experiences for the students who are not giving presentations. The study described here focused on formal student presentations in front of the whole class.

While many publications have documented benefits to students who teach each other (e.g., Reiserer et al., 2002; Oitizzger and Kallgren, 2004; Kågesten and Engelbrecht, 2007), very few have assessed whether or not the experience is beneficial for those listening to the student presenters. Investigators in pharmaceutical education used direct measures (pre- and post-tests) to document student learning as a result of hearing presentations from their peers (Atayee et al., 2012; Malcom and Hibbs, 2012; Thomas and Macias-Moriarity, 2014); other studies are limited to self-reported comments about learning and efficacy of learning from peer presentations (Marvell 2008).

Stevenson and Sander (2002) showed that student presentations was among the least favorite ways for students across multiple disciplines to learn. On the other hand, students may present concepts in a way that is more relatable and more enjoyable for students so that it leads to greater learning gains than if an instructor presented the same concepts (Bohmbach, 2000; Velez et al., 2011). Some students have reported feeling a greater motivation to engage during presentations from their peers because they feel more comfortable (Velez et al., 2011) and because they seek to support each other (Marvell, 2008). Both learning gains and student preferences were included in this study.

METHOD

Participants and Classroom Format

A junior-level Environmental Studies course, "The Environment and Food Systems," was the focus of this investigation in fall 2015 at a medium-sized university in Wisconsin, USA. The class size was 25 students who ranged from sophomore to senior status and who had a wide variety of academic majors. The group presentation assignment helped meet one of the overall course learning outcomes: "describe key effects of obtaining a variety of foods on wild populations, soils, climate, water quality, water quantity, or social justice." Each team researched examples of how a type of food affects the environment during the growing, processing, distribution, or consumption steps of the food system. Environmental impacts included changes to wild populations, soils, climate, water quality, or water quantity. The assignment was introduced in the first week of class, and presentations in groups of 3-4 began in the fourth week of class (Table 1).

Table 1: Sequence of assessments with presentation topics

Date	Assessment and Topic	Summary of Formal and Informal Assessments
9/14/2015	Pretest: all topics	Briefly describe environmental effects of producing and obtaining each type of food.
9/14/2015	Topic interest survey: all topics	How often have you thought about this topic? (Likert scale responses)
9/30/2015	Instructor presentation & activity: Vegetables	Discussion questions in groups using a graph and table
9/30/2015	Post-test: Vegetables	Briefly describe environmental effects of producing and obtaining vegetables.
10/12/2015	Student presentation & activity: Fruit	Family Feud-type game
10/12/2015	Instructor presentation & activity: Nuts	Team quiz: do these characteristics of nuts make them beneficial or harmful?
10/12/2015	Post-tests: Fruit and Nuts	Briefly describe environmental effects of producing and obtaining fruits and nuts.
10/14/2015	Student presentation activity: Wild game	Pictures around room of flora and fauna: how would altering populations affect ecosystem?
10/14/2015	Student presentation activity: Fish	Statistics, then questions, then small group discussion, ended with large class discussion
10/14/2015	Post-tests: Wild Game and Fish	Briefly describe environmental effects of producing and obtaining wild game and fish.
10/19/2015	Instructor presentation activity: Shellfish	Role-play demonstration, then use of app for finding sustainable fish to purchase
10/19/2015	Post-test: Shellfish	Briefly describe environmental effects of producing

		and obtaining shellfish.
10/21/2015	Student presentation activity: Soy	Interactive small group quiz listing products that did or did not contain soy
10/21/2015	Student presentation activity: Dairy	Two truths and a lie with environmental impacts of dairy
10/21/2015	Post-test: Dairy	Briefly describe environmental effects of producing and obtaining soy and dairy products.
10/28/2015	Instructor presentation activity: Rice	Bluff quiz game: 2 teams, stand if you know the answer or want to bluff
10/28/2015	Post-test: Rice	Briefly describe environmental effects of producing and obtaining rice.
11/2/2015	Student presentation activity: Palm Oil	Guess which pictures of products do or do not contain palm oil
11/2/2015	Student presentation activity: Beer	Two truths and a lie: 2 teams, with environmental impacts of beer
11/2/2015	Post-tests: Palm Oil and Beer	Briefly describe environmental effects of producing and obtaining palm oil and beer.
12/9/2015	End of semester survey	What change would you suggest for the format of student presentations in order to promote the most *learning*?
12/9/2015	Anonymous feedback survey	To what extent did working in groups help or hinder your *learning?*

Sequencing the presentations for early in the semester allowed an assessment of learning gains that were based on the presentations rather than on additional course readings and experiences. Presenting discrete topics early in the semester also allowed for more systems thinking synthesis building on those topics later in the semester.

Seven student group presentations were interspersed with four presentations of the same format given by the instructor, for a total of 11 different food topic presentations of the same format. A student employee who was not taking the class observed all presentations and rated all of them, including the instructor's presentations, using the presentation scoring rubric that the instructor also used for student grading. A pre-test was given in the first week of class to assess student knowledge on each of these 121 food topics, and the same question was asked immediately after each presentation for the post-intervention test: "Briefly describe environmental effects of producing and obtaining this type of food." Learning gains for each student were assessed using the same scoring rubric for the pre- and post-tests, without revealing scores after the pre-test (Table 2). A survey of student interest in each food topic was also administered with the pre-test and again at the end of the semester.

Table 2: Pre/post-test scoring rubric

Exemplary (5)	Fine (4)	Mostly Competent (3)	Developing (2)	Insufficient (1)
Details of how this food affects the environment in 3 or more ways that are particularly significant for this food. Correct cause and effects identified for each.	Three correct environmental impacts explained that are somewhat linked to this food type.	Two correct environmental impacts explained that are clearly linked to this food type.	One or two correct environmental impacts listed, but with few correct details, and barely specific to this food type.	One environmental or social impact mentioned but without details specific to this food type. Some blatant inaccuracies.

The scoring rubric for the test was not shown to students, but a sample of an excellent answer for a different food topic was shown prior to the pre-test. Although the pre-test asked students to write 11 short paragraphs on the same day, and the post-test was spread out to include just 2 paragraphs on each day, the same amount of time was allocated for each topic of both the pre- and post-tests.

Addressing Effectiveness of Student Presentations

The presentation assignment was designed to overcome three of the obstacles listed in the Introduction above that could reduce student learning from peer presentations. (1) The concern that students might pay less attention to peers presenting was addressed by having a quiz after both student and instructor lessons. (2) The instructor gave students a set of pre-selected food categories from which students could select preferences for a presentation topic. The instructor chose the set of food categories based on scope of environmental impacts. (3) To address the concern that students might not present information clearly, scaffolding for the assignment included: a detailed scoring rubric along with requirements for an annotated bibliography, presentation outline, draft, instructor meeting, and presentation practice. In addition, instructor presentations of the same format provided examples for the assignment. Three full days of class time were allocated for students to work together.

The instructor referred to this assignment during class as "teaching" rather than "presenting" in order to help students consider a format used by teachers rather than a formal presentation format. Students' experiences with formal *presentations* in other classes typically do not require interacting with the audience or using a pace focused on learning rather than eloquence. This group teaching assignment also required that student groups plan an activity for class interaction as part of the 25-35 minutes allocated to each group. Examples suggested to students included structured discussion, reflection assignment, game, role-playing scenario, and/or interacting with physical props. Table 1 summarizes the activities chosen for each lesson. They included "interactive," "constructive," and "active" modes as described by the Differentiated Overt Learning Activities (DOLA) framework (Meneske et al., 2013). However, sample sizes did not allow a rigorous comparison of these different modes for active learning. Short video clips were noted as acceptable for part of the group presentation time, but not as the activity. Thus the student presenters were asked to follow the same interactive lesson format and technology that the instructor uses to promote learning. Other instructors have also designed student presentation assignments that help promote active teaching rather than simply lecturing by the student groups (e.g., Malcom and Hibbs, 2012; Thomas and Macias-Moriarity, 2014).

After students submitted a list of three preferred topics from the list of options, the instructor assigned them to groups of 3-4 based on these preferences. Students did not have a chance to consult with each other about preferred topics, so the groups were not self-selected. Assigning groups randomly is known to boost both individual and group outcomes (Hinds et al., 2000; McClelland, 2012; Shimazoe and Aldrich, 2010). Individual scores, as well as team-member evaluation via catme.org helped hold individuals accountable for their contributions. Catme is a system of web-based tools that uses best practices in facilitating peer evaluation (MacAlpine, 1999; Ohland et al., 2012). After students completed a calibration exercise for the evaluation tool, they rated five different dimensions of self and peer contributions to the team. Team work skills were a part of the learning outcomes for the group presentation assignment, but they were not assessed as a part of this investigation.

Statistical Analyses

Using the difference between pre- and post-test scores, the change in student understanding was compared between student group-led and instructor-led topics with a paired sample t-test. Each student's scores were averaged among the 7 student-led topics and among the 4 instructor-led topics, so data were paired by student. The same analysis procedure was used to compare responses for a topic preference survey question asked at both the start and end of the semester. Two students missed either the first or end survey, so those data were excluded. A Kruskal-Wallis rank-sum test was used to compare the change in student understanding on their own presentation topic (n = 25) versus the topics presented by other students (n = 202). If a student missed either a pre- or post-test, data were excluded for only the topics for which no comparison was possible.

Linear regression analyses were used to test whether any of the following factors at the topic level helped predict student learning gains on the pre- and post-tests: presentation score (based on the rubric scoring by a student employee), length of activity within the presentations, total presentation length, and presentation sequence. Each presentation topic was a separate data point with the difference between pre- and post-tests averaged across all students for each topic (n = 11). Data analyses were conducted using R software (R Core Team, 2013) and SPSS, version 25. Significance was assessed for each test at the alpha = 0.05 level.

FINDINGS

Learning Gains

Scores on the question "Briefly describe environmental effects of producing and obtaining this type of food" increased by an average of 2.06 points (out of 5) on the post-instruction quiz for topics presented by the instructor (SD = 0.86, n = 25) and an average of 1.89 points for topics presented by student groups (SD = 0.64, n

= 25). There was no significant difference in mean learning gains for student-led versus instructor-led topics (t= 1.165, df = 24, p = 0.255).

Learning gains using the same paired pre- and post-instruction tests were compared for students on their own topics and on topics taught by other students. Based on a Kruskal-Wallis rank-sum test, there was no significant difference between the learning gains on students' own topics and those presented by others, including the instructor.

Total presentation length, sequence during the semester, and presentation score each did not significantly affect mean learning gains (Table 3). The length of the activity portion of the presentation had a significant negative relationship with mean learning gains ($F(1,9)=9.66$, $p=0.01$; $R^2 = 0.52$; Fig. 1). Presentations with longer activities (or a longer percent of the overall presentation time) consistently resulted in lower learning gains than presentations with more traditional lectures. This relationship was not affected by whether students or the instructor presented the topic ($p>0.05$).

Table 3: Linear regression results for presentation variables that could affect learning gains (n = 11)

	Coefficients	SE	t Stat	P-value
Presentation length	0.003	0.019	0.180	0.861
Sequence	-0.026	0.051	-0.508	0.624
Score	0.041	0.052	0.777	0.457
Activity length	-0.116	0.037	-3.108	0.013

Student Interest

The question asked on surveys before and after each topic presentation was, "How often have you thought about the effects of producing and obtaining this type of food outside of your work for class?" Students answered the question using a Likert scale of 0-4, where 0 was labeled "never," and 4 was labeled "at least once/week." For all topics combined, the average Likert score increased by 0.89 (SD = 0.79, n = 23). There was no significant difference in responses for student-led versus instructor-led topics (paired t= -1.10, df = 22, p = 0.282).

A separate, anonymous survey at the end of the semester included general questions about preferred learning methods for classes more broadly, in order to compare student presentations with other teaching formats. Results showed that tours/guest lectures were "most preferred" and tied for being the "most effective" format for courses (Table 4). All options from the survey are presented in Table 4, including the category "Other," although few students specified what they meant by "other" where asked.

Table 4: Mean ranks of learning formats with 1 being the best on end-of-semester survey (n = 22)

Learning format	Preferred	Most effective
Tour or lecture by guest	1.9	2.4
Interactive lesson by instructor	2.9	2.4
Watching documentary film	3.0	3.4
Interactive lesson by well-prepared students	4.2	4.7
Discussion	4.4	4.5
Reading	5.1	4.1
"Other"	6.0	6.3

"Interactive lessons by the instructor" was the format that tied for the "most effective" ranking, and it ranked second highest for "most preferred." "Interactive lessons by well-prepared students" ranked 4th for student preference and nearly last for effectiveness.

The survey requested feedback about the group presentation project ("What change would you suggest for the format of student presentations in order to promote the most *learning*?"). On this open-ended question, 8

students (32 %) suggested they wanted more guidance on key information to include in their presentations. Three students suggested spreading the presentations throughout the semester, and 2 students suggested having smaller groups.

Students were also asked to rate on a Likert scale "How much I learned" from other student presentations and from their own presentations. This estimate of perceived learning showed that 57 % of students reported learning "quite a bit" or "a great deal" from other students' presentations, and 86 % reported learning "quite a bit" or "a great deal" from their own presentation (Fig. 2; n = 21). Due to anonymity of this survey, correlations could not be investigated for student perceptions of learning with measured learning gains.

The end-of-semester survey also included the question, **"**To what extent did working in groups help or hinder your *learning*? Choose all that apply." Of the five statements with which students could agree or disagree (Table 5), the most commonly selected ones for agreement were "I practiced skills such as project coordination, task delegation, or overcoming obstacles" (50 %, n = 22) and "My group helped me learn the material in a more memorable or fun way" (45.4 %, n = 22).

Table 5: Percent of students who recorded agreement with each of these statements on the end-of-semester survey (n = 22)

Survey statement	% agreeing
I practiced skills such as project coordination, task delegation, or overcoming obstacles	50
My group helped me learn the material in a more memorable or fun way	45.4
Student presentations were better because of working in groups	36.4
Student presentations were worse because of working in groups	31.8
My group only detracted from my time or caused stress	22.7

DISCUSSION

Students preferred instructor lessons to peer lessons and also reported instructor lessons to be more effective. However, pre- and post-test scores showed equal learning and topic involvement resulting from each of these formats. Students may not be aware of their true feelings or which strategies help them learn more effectively (Anderson and Bourke, 2000 p. 61; Bjork et al., 2013). Metacognition is particularly challenging for some students, who may overestimate learning from easier learning experiences (Kruger and Dunning, 1999; Bjork et al., 2013). In addition, learning gains demonstrated by the pre-and post-instruction tests may not necessarily characterize the long-term learning gains resulting from classroom instruction. Nevertheless, these results suggest that allocating class time to hearing student presentations does not have to mean less productive learning time for the student audience. Given that preparing group presentations can make learning more enjoyable, memorable, and relevant for practicing skills such as teamwork and information literacy than lectures from the instructor, the classroom time for student presentations should not be discredited.

Although students ranked learning from peer lessons as the least effective learning format, the same survey also resulted in 57% of students stating they learned "quite a bit" or "a great deal" from other students' presentations. The perceived learning from their own presentations was much higher than from others' presentations, as expected by the generation effect (Foos et al., 1994) and benefits of learning by teaching (Schwartz et al., 2016). Learning gains measured here did not support this difference, though social loafing in group presentations or specializing too much for one aspect of the presentation might help explain this difference from the benefits of solo teaching.

It is not entirely clear which aspect of the peer lessons made that a less desirable format for these students than instructor lessons (Table 4), but a survey of 395 first-year British university students reached a similar conclusion about student presentations as least desirable (Sander et al., 2000). Our survey suggested that less than half of the students found it "memorable or fun" to work in groups, and 7 students found presentations worse because of the groups (Table 5). Five students agreed with the statement that group members detracted from time or caused stress (Table 5). Students may have disliked preparing to do their own graded presentation, listening to peers, and/or simply disliked the frequency of pre- and post-test assessments associated with presentations in this course. As suggested by 3 students on the survey, spreading the presentations throughout the semester would have made the process less repetitive: all 11 presentations with quizzes took place during weeks 4-9. Shorter presentations also may have been preferred for these course topics. A meta-analysis of psychology courses indicated that group work lasting only 1-3 class periods was more effective than group projects lasting more than a half semester (Tomcho and Foels, 2012), but also that learning outcomes were met more effectively when groups did not have a formal presentation.

The absence of a relationship with presentation sequence suggests that testing experience or fatigue did not influence the estimate of learning gains. Learning gains declined as class activity length increased, possibly due to less content coverage and distraction from the main concepts tested. Additional guidance from the instructor could have helped ensure that the activities focused on key concepts appropriate for the post-test essay, or to remind students that many ideas from the activities would be relevant for the essay. This study did not investigate how learning gains would compare if there was zero time allocated to an activity, but the active learning literature suggests that learning would be reduced (Umbach and Wawrzynski, 2005; Michael, 2006; Slavich and Zimbardo, 2012). In addition, the activity formats were highly variable, so activity length may have obscured an unmeasured variable in teaching effectiveness.

CONCLUSIONS

These data suggest that with significant guidance and clear presentation parameters, students can learn as much from peer presenters as from interactive lessons by the instructor. The learning gains and preferences demonstrated in this course would certainly vary with skills and interests of both the students and the instructor. However, strategies such as scaffolding the assignment with intermediate drafts, providing examples, and working in teams can improve the effectiveness of student presentations. Several students in this course noted on the final survey that they wanted more guidance on key information to include in their presentations. Additional guidance from the instructor could reduce the opportunities to practice information literacy skills and to personalize the topic, but it would enhance confidence in the presentations from other students. If students have confidence that their peers are presenting essential and correct information, it enhances learning from and appreciation of other students' presentations.

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