

Interactive discussion versus lecture for learning and retention by medical students

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Abstract

Introduction: Medical educators search for the best methods for teaching medical students. With improvements in technology, it became relatively easy for instructors to supplement lectures with electronic slideshows or to create internet-based presentations with minimal or no instructor interaction. More recently, educators have focused on making teaching more interactive.

Methods: During the third-year paediatric rotation, students were assigned to a slideshow lecture format or an interactive discussion format. Students completed a 20-item multiple-choice knowledge test on three occasions: a baseline test before the teaching session, a second immediately after the teaching session and another 6 months after the teaching session. Test scores and changes in test scores were compared between the groups. Number of student–teacher interactions and student evaluations of the teaching sessions were also compared between groups.

Results: Both groups had a statistically-significant improvement from pre-test to post-test, as well as pre-test to 6-month and post-test to 6-month, but there was no difference between the groups. There were more student interactions in the discussion groups: 26% of students in the lecture groups compared to 77% in the discussion group. Students in the lecture group indicated that they felt more prepared, however significantly more students (74%) in the discussion group stated that they enjoyed this method of teaching compared to 51% of students in the lecture group.

Conclusions: We found that students taught with passive lecture or active discussions had similar test scores despite significantly more interaction in the discussion group, but they seemed to enjoy the discussion method more than the lectures.

Keywords: interactive; lecture; passive; learning; student.

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Introduction

Since the Flexner Report was published in 1910, medical education in the United States has gone through many transformations prompted by a desire to determine the best method for medical students to acquire the knowledge needed to provide clinical care (Harder, 2013). Initially, teaching was primarily in a lecture setting often supplemented with smaller laboratory teaching sessions. However, with improvements in technology, it became relatively easy for instructors to add electronic slide shows to lectures or create internet-based learning with minimal student–instructor interaction (Harder, 2013; Stein, Shibata, Bautista, & Tokuda, 2010). More recently, educators have once again focused on interactive learning, problem-based learning and small group learning, attempting to improve educational content and delivery. Some evidence suggests that small group discussion and problem-based learning are preferred by students (Anyachie et al., 2011; Brinton, Jarvis, & Harris, 1984; Chang, Yang, See, & Lui, 2004), but studies examining students' performance on tests of knowledge, such as the United States Medical Licensing Exam (USMLE), have shown mixed results when comparing curriculum approaches (Blake, Hosokawa, & Riley, 2000; Enarson & Cariaga-Lo, 2001; Koles, Stolfi, Borges, Nelson, & Parmelee, 2010; Nieder, Parmelee, Stolfi, & Hudes, 2005; Thomas, Aeby, Kamikawa, & Kaneshiro, 2009).

Adult learning theory would suggest that interactive, learner-centered teaching will improve the learning and retention of knowledge by medical students (Knowles, Holton, & Swanson, 1998), but there are few studies that have explored educational outcomes, and even fewer where students do not choose to be in the interactive teaching group. The purpose of this study was to compare medical student learning from an interactive discussion with learning from a slideshow lecture. We hypothesised that third-year medical students assigned to have an interactive discussion about asthma would have improved test scores compared to medical students who received a traditional slideshow lecture on asthma.

Methods

Subjects

Third-year medical students at the University of Wisconsin School of Medicine and Public Health, during their paediatric clinical rotation from July 2012–June 2013, were eligible for the study. There were eight clinical blocks in the year, with approximately 15 students per block. As part of this clinical rotation, students attended regularly scheduled, mandatory teaching sessions to provide core knowledge of paediatric illnesses, including a session on the acute management of asthma. In order to account for knowledge and experience gained by students over the course of the year, student blocks were alternately assigned to a lecture on asthma using slides or a discussion about asthma; these are hereafter referred to as the “lecture” or “discussion” group. Approval was granted by the University of Wisconsin Social/Behavioral Science Institutional Review Board prior to study commencement. Students enrolling in the study signed a written consent to participate, and test results had no effect on the students' paediatric clerkship grades. In addition, all tests and surveys were de-identified and assigned ID numbers to evaluate change in test scores. The results are reported in aggregate.

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Teaching sessions

In order to prevent bias from teaching style and teaching experience, a single instructor (JM) provided all of the teaching sessions during the study. In the lecture groups, the instructor used a prepared electronic slideshow lecture describing the pathogenesis, physical exam, differential diagnosis and treatment of asthma. In order to allow the students to spontaneously participate, the teacher did not give the students any instructions about how they might participate in the lecture. At the end of the lecture, the instructor asked the students if they had any questions.

In the discussion groups, the instructor prompted the group of students to talk about the pathogenesis, physical exam, differential diagnosis and treatment of asthma. The instructor wrote their responses on a white board and discussed them throughout the sessions, emphasising the correct information about the topic. A second physician (SH or SS) observed each teaching session (lecture or discussion) to ensure that all the knowledge tested was covered in each session. In addition, in the last six of the eight sessions, this observer monitored active student participation by tallying student questions, answers and other comments. The length of the teaching session, including pre- and post-test, was limited to 60 minutes for both the lecture and discussion groups.

Testing

Each student completed a 20-item multiple-choice test on three occasions: a baseline test given before the teaching session (pretest) to account for baseline knowledge, a second immediately after the teaching session to assess knowledge acquisition (post-test) and a third 6 months after the teaching session to assess retention of knowledge (6-month). The questions on the tests were identical, but with variation in the question order on each version of the test. Students received no feedback on their test performance during the study. This knowledge test was developed for this study by the investigators. As this was a pilot study, the test was not previously validated, but the questions and content were agreed upon by three critical care physicians who are experts in the acute care of asthma. They assessed the test for relevance, accuracy and difficulty of questions.

Evaluations

After the teaching session, students evaluated the session, the instructor and method of teaching using 4- or 5-point Likert scales. In order to identify other occasions where students may have learned about asthma, at the 6-month follow-up, students were asked to list which rotations they had taken since the teaching session, whether they had received any other teaching about asthma, how many patients they had cared for with asthma, and if the paediatrics teaching session had helped the student in caring for patients with asthma.

Statistical methods

Test scores and percent changes in test scores between the pretest, post-test and the 6-month test are reported as mean +/- standard deviations. The analysis was conducted using the intent-to-treat principle. A two-sample t-test was used to compare test

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scores and percent changes in test scores between groups. Normal probability plots were examined to verify the normality assumption. Changes within each group were evaluated using a paired t-test.

Evaluation items were summarised using medians and interquartile ranges. The nonparametric Wilcoxon rank-sum test was used to compare individual evaluation items between groups. Furthermore, we compared the percentages of students in each group who answered a question positively using Fisher’s exact test. A positive response was defined as a Likert-scale response of ≥ 3 for the first four questions and ≥ 4 for the others. All *p*-values are two-sided and $p < 0.05$ was used to define statistical significance. Statistical analysis was conducted using SAS software (SAS Institute Inc., Cary NC) version 9.3.

Results

Knowledge

A total of 102 students attended an asthma teaching session, and all completed the pretest (58 in discussion group, 44 in lecture). Of those, 99 students (55 discussion, 44 lecture) completed the post-test, and 53 students (29 discussion, 24 lecture) completed the 6-month test. Analysis of the tests is shown below in Table 1. During only one of the discussion sessions, the observer noted that one test question was not covered by the instructor. Despite this, there was no statistical difference in how that group answered the question when compared to the other groups. Therefore, all data is presented as an aggregate of all the sessions.

Table 1
Average Student Test Scores for Discussion and Lecture Groups for PRE-Test, POST-Test, and 6-MONTH Test

Score on 20 item test	Discussion group			Lecture group			<i>p</i> -value ¹	<i>p</i> -value ²	<i>p</i> -value ³
	Number of students	Mean score	SD	Number of students	Mean score	SD			
Pretest	58	14.7	2.1	44	15.1	1.9	.	.	0.259
Post-Test	55	17.5	1.4	44	17.9	1.9	.	.	0.169
6-month	29	17.1	1.6	24	16.6	1.6	.	.	0.279
Change pre-to post-Test	55	2.7	1.8	43	2.8	1.8	< 0.0001	< 0.0001	0.687
Change pre-to 6-month	29	1.7	2.0	24	1.5	2.1	0.0001	0.0018	0.735
Change post-to 6-month	28	-0.8	1.6	23	-1.5	1.8	0.0182	0.0005	0.107

p-value¹: P-value for evaluating changes from pre to post, pre to 6-month and post to 6-month within discussion group

p-value²: P-value for evaluating changes from pre to post, pre to 6-month and post to 6-month within lecture group

p-value³: P-value for the comparison between discussion versus lecture group

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As shown in Table 1, students in both groups had similar pretest scores. Both groups had a statistically significant improvement from pretest to post-test, but there was no difference between the groups. Both groups also had a statistically significant change from pretest to 6-month and post-test to 6-month, but there was no difference between groups (see Figure 1).

Student interaction

Student interactions (comments, questions, answers) were significantly higher in the discussion groups: 26% of students participated during the lecture groups and 77% of students participated during the discussion groups ($p < 0.001$). Figure 2 shows these results in aggregate and in separate blocks.

Evaluation

There were some significant differences in how the students perceived the teaching method enhanced their learning about asthma, their rating of the speaker and their rating of the mode of teaching (Table 2). Compared with the discussion group, students in the lecture group indicated that the session better enabled them to describe

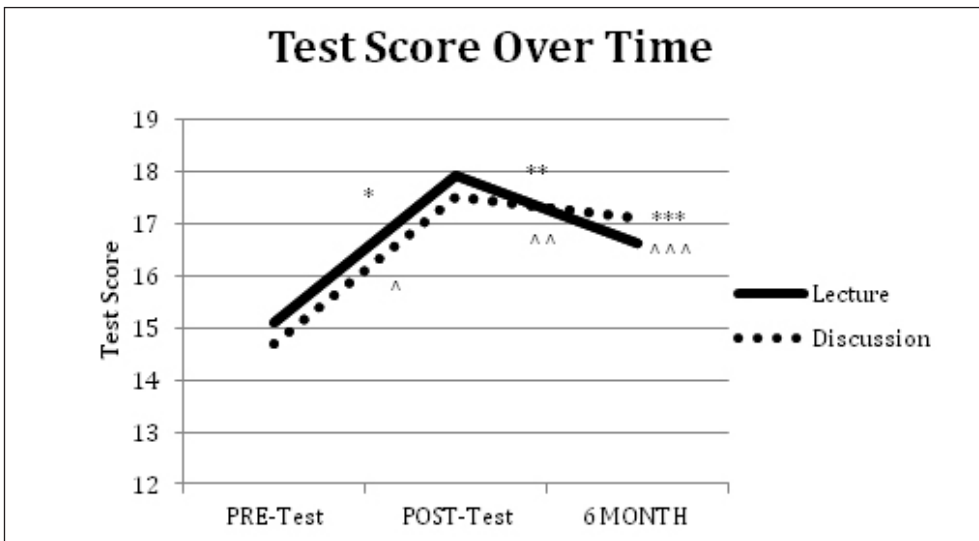


Figure 1. Test scores for lecture and discussion groups.

Statistically significant change ($p < 0.05$) within lecture group over time: pretest to post-test (*), post-test to 6-month test (**) and pretest to 6-month test (***)

Statistically significant change ($p < 0.05$) within discussion group over time: pretest to post-test (^), post-test to 6-month test (^) and pre-test to 6-month test (^^)

There were no significant differences between groups at any time.

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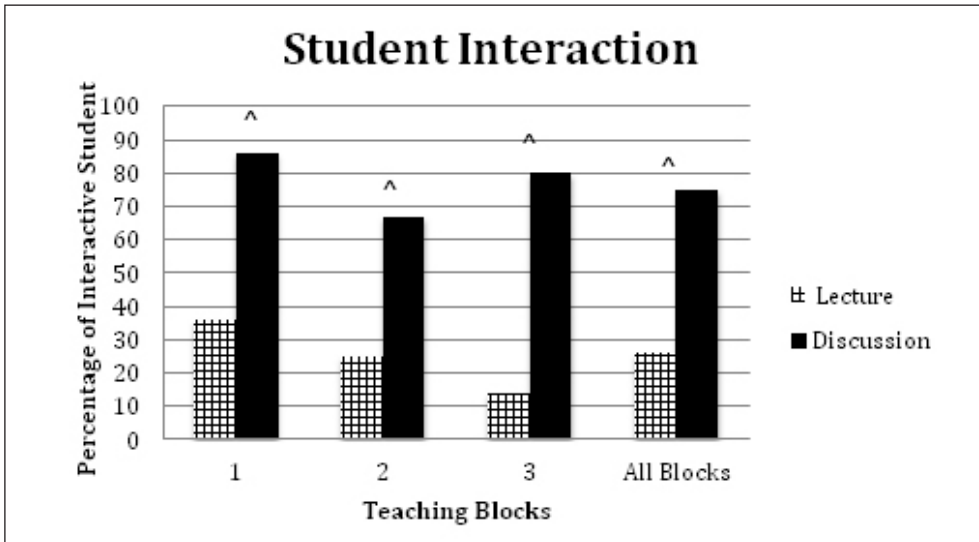


Figure 2. Percentage of student interaction between lecture and discussion groups.

[^] Denotes statistically significant difference ($p < 0.05$) between the lecture and discussion groups.

the pathophysiology ($p = 0.031$) and the acute management of asthma ($p < 0.001$), and they rated the quality of the audiovisuals higher ($p = 0.016$). Significantly more students (74%) in the discussion group stated that they enjoyed the discussion method of teaching compared to 51% of students in the lecture group who stated that they enjoyed the lecture method ($p = 0.028$). While not statistically significant, students in the lecture group trended towards feeling more positive about the speaker’s preparation (p -value 0.054) and the delivery of the presentation (p -value 0.062) than students in the discussion group. At the end of the study, we asked a final question on the evaluation: “Do you feel that you have increased your knowledge and ability to translate what you learned into practice?” In the lecture group, 95% of students answered “yes.” In the discussion group, 93% of students answered “yes”.

As part of the 6-month test, we asked students what rotations they had experienced since our teaching session, if they had received any other formal teaching on asthma, if they had treated patients with asthma and if this lecture had helped them in the management of those patients. Twenty-five percent of students in the lecture group and 24% of students in the discussion group received additional teaching. Forty-eight percent of students in the lecture group had cared for patients with asthma, and 55% of students in the discussion group had cared for patients with asthma.

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Table 2
Evaluation Scores Between Lecture and Discussion Groups

Question	Lecture group	Discussion group	
This lesson improved my ability to: <i>4-point scale: 1 = no improvement, 2 = less than expected, 3 = met expectations, 4 = more than expected</i>	% Answer ≥ 3	% Answer ≥ 3	<i>p</i> -value * statistically significant (<i>p</i> -value < 0.05)
1. Describe the pathophysiology of asthma	97.6	83.7	0.031*
2. Describe the initial evaluation of a child with increased work of breathing	92.7	81.4	0.125
3. List the differential diagnosis of a child with increased work of breathing and wheezing	92.7	90.7	0.742
4. Describe the acute management of a child with an asthma exacerbation	100	74.4	<0.001*
The speaker <i>5-point scale: 1 = poor, 2 = below average, 3 = average, 4 = very good, 5 = excellent</i>	% Answer ≥ 4	% Answer ≥ 4	
5. The speaker's preparation was	85.4	67.4	0.054
6. The delivery of the presentation was (how it was said)	73.2	53.5	0.062
7. The quality of the audio visuals were	72.5	46.5	0.016*
8. The presenter's response to questions was	85.4	76.7	0.314
Mode of teaching <i>5-point scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree</i>	% Answer ≥ 4	% Answer ≥ 4	
9. I enjoyed this method of teaching	51.2	74.4	0.028*
10. I learn well by this method of teaching	63.4	72.1	0.394
11. This method of teaching is boring	41.5	25.6	0.122
12. This method of teaching is intimidating	19.5	11.6	0.317

Discussion

In this study, we were not able to demonstrate a significant difference in performance in a knowledge test between students taught using a lecture or an interactive discussion. Both groups improved on post-testing and retained knowledge after 6 months. Despite a significant difference in the amount of student participation between teaching methods, we were unable to demonstrate any difference in the amount of learning (based on the pretest to post-test difference) or retention (based on the post-test to 6-month difference) that was related to the teaching method.

Previous studies have shown similar findings. Bulstrode, Gallagher, Pilling, Furniss and Proctor (2003) randomised students to learn about trauma and orthopedics via lecture or "donut round" (discussion). Multiple-choice test scores obtained after the course, at 10 weeks and at 17 months were similar between both groups (Bulstrode et al., 2003).

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Fischer et al. (2004) randomised third-year medical students to learn about diabetes and hypertension in pregnancy either via lecture or small group discussion. Students had similar test scores immediately after the teaching session and at the end of the clerkship. While test scores were similar, students enjoyed the small group discussion more than the lecture (Fischer, Jacobs, & Herbert, 2004). Our study showed similar findings in regard to both test scores and evaluation. Students in the discussion groups showed higher preference for that method of teaching than students in the lecture groups. While students were more accustomed to a lecture format, they did not enjoy that method of teaching.

Interestingly, students in the lecture group felt more prepared after the teaching session than students in the discussion group. They also felt that the speaker's preparation and delivery of the presentation were better, though this did not quite reach statistical significance. Collectively this may have been due in part to the relative inexperience of the instructor with the discussion-based format. Given that, it is perhaps notable that students in the discussion group did no worse on the examination, and in fact enjoyed the conference more frequently. It is interesting to hypothesise that with more experienced instructors (and perhaps learners more accustomed to this style), a significant benefit might be found for the discussion group. Future work will be designed to examine this hypothesis.

One concern with the 6-month follow-up was the possible influence of additional experiences and teaching about asthma the students may have received. To account for this, in the 6-month survey, students were asked if they had received other teaching about asthma or cared for patients with asthma. There was similarity in both groups in these experiences, and most students had not received additional teaching about asthma. Thus, we are confident that subsequent experiences did not likely influence our results.

It is important to point out several limitations of our study. Since we were also unable to control for the students' baseline understanding of asthma, we used a pretest before the teaching sessions. As part of the study design, we purposely did not have students prepare ahead of the sessions. Advanced preparation may have enhanced students' ability to participate in the session, which may have had a greater impact on the discussion-based method, limiting our ability to detect a difference. This will be tested in future studies.

The same multiple-choice questions were used for the pretest, post-test and 6-month test. It is possible that the improvement in test scores could partially be attributed to familiarity with the test questions. In order to minimise this, students were not given the correct answers to the questions and the question order was randomised.

Multiple-choice tests may test students' ability to recognize a correct answer, but not their understanding of the material or the ability to apply the knowledge in a clinical practice. In addition, while we were able to show that students had similar increases in test scores after each type of teaching session, it is unclear how well students will apply this knowledge to clinical practice. The use of simulation, standardised patients or an

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objective structured clinical examination (OSCE) may test a learner's understanding and application of skills better than an unvalidated multiple-choice test (Miller, 1990; Swanson, Norman, & Linn, 1995) but would require significantly greater resources to perform.

In order to minimise bias related to different teaching styles, training or experience, we used one instructor for the entire study. As mentioned above, a limitation, therefore, may be due to the teaching style and experience of the instructor. On completion of the study, the instructor reflected that it was less stressful to teach using the lecture format than using the discussion method. During the lecture, the instructor could control the flow and organisation of the teaching session. Both the instructor and physician observer noted it was difficult to ensure that all of the key information was covered during the discussions. Because the discussion sessions were more learner-centred, some topics may have been more thoroughly examined, forcing other topics to be covered quickly or less completely. In a normal, non-research setting, such topics may have been deferred to another teaching session or not covered at all if the students exhibited adequate understanding during the discussion. In addition, the teacher's lecture style may have evolved over time, and the instructor's ability to facilitate an interactive session may change with experience. Another limitation is the instructor was part of the study and may not have had an unbiased approach to the teaching method.

Finally, the generalisability of this study is difficult to determine. One could hypothesise that certain topics might be more amenable to lectures rather than active discussions. Teaching and learning more abstract concepts, for example, might require more discussion and student interaction. Alternatively, topics with very specific factual information might be best learned in a traditional lecture format.

Despite these limitations, our study design had several specific strengths. As opposed to several previous studies, students were allocated to their specific groups in an assigned fashion rather than based on their stated preference of learning styles. This more closely reflects actual practice in most situations. In addition, we focused not only on short-term retention of the material but also retention over several months, in addition to student's evaluations of the lecture. While we did not show a change in retention between the groups, our results did determine that students were, in fact, much more interactive in the discussion groups and enjoyed this method more. It seems likely that, over time, more engaged and enthusiastic learners would out-perform others.

Future studies will build on the work presented here. We plan to repeat this study using teachers with different levels of clinical experience, as well as experience teaching in an interactive format. Future studies will also attempt to assess student knowledge using alternative methods to better assess comprehension of the material. In addition, we are interested in whether the experience level of the trainee impacts the relative benefits of discussion versus lecture formats, as the level of discussion may be higher with more senior trainees. Finally, we will examine whether students experiencing repeated discussion sessions benefit more than a single teaching session.

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Conclusion

In conclusion, we found that students taught with either a lecture or active discussions performed equally well on a cognitive test immediately after the teaching session and 6 months later. We did, however, demonstrate that students showed more participation in the interactive discussions. Although students in the lecture group were more inclined to feel that they could describe the pathophysiology and management of a child with asthma, the students in the discussion group tended to prefer the discussion method of teaching.

Acknowledgement

We would like to thank JE for help with statistics. We would also like to acknowledge AV, MD, Paediatric Clerkship Director at the University of Wisconsin School of Medicine and Public Health for allowing us to teach the 3rd-year medical students in this fashion during their clerkship.

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