

## Improving Student Ratings through Lecture Based Tutoring

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### Abstract

Lecture based tutoring is a new active learning technique. The instructor selects a student and asks the student a question. If the student cannot adequately answer the question, the teacher tutors the student to an appropriate answer. By asking each student in the class many questions during the semester, the instructor is aware of each student's progress on learning outcomes. Furthermore, the instructor can provide learning experiences for each student in the class. By changing a course from lecture based to lecture based tutoring, the student ratings of the instructor improved by a statistically significant amount.

### Keywords

Active Learning, Lecture Based Tutoring, Student Ratings

### 1. Introduction

Researchers publish numerous papers and books on techniques and methods to improve student learning. From improved projects [Johnson (1999), Easton and Cassone (2006)] to active learning techniques [Silberman (1996), Myers et al. (1993), Prince (2004)], the amount of research done in improving learning is extensive. The goal of active learning techniques is to help students master the material faster, which is accomplished by engaging students in classroom discussions. This paper describes a new active learning technique called lecture based tutoring. Changing a class from a lecture format to a lecture based tutoring style dramatically improved the instructor's student ratings.

A common active learning technique is called turn to your partner (TTYTP) [Smith (1995), Faust and Paulson (1998)]. Briefly, the teacher asks a question and the students turn to their neighbor to discuss possible answers. After a short time, the instructor asks for feedback from some of the partners.

Small group discussions (SGD) are also a popular active learning technique [Hillyard et al. (2010), Deslauriers et al. (2011)]. In this scenario, the instructor divides the class into groups and these groups have a discussion. The groups typically elect a spokesperson for the group. When the class rejoins, all groups report the discussion that occurred.

The above research shows that both TTYTP and SGD provide improved learning outcomes over a standard lecture. However, these methods still have several shortcomings. In both cases, the instructor has given the students time to discuss "the desired topic." The students may briefly discuss the topic, but then some discussions change to less desired topics, which results in

wasted class time. After a short time, some discussions are far off track and other groups need additional time. Determining when to reconvene the class is a delicate decision.

The larger problem is that some groups may derive an incorrect response. In certain situations, the instructor may not even be aware and the students believe they are correct. In this case, class time has been spent teaching incorrect practices and principles. These type of problems frequently occur when a teacher relinquishes control of the classroom.

This paper presents a new active learning technique that does not allow the instructor to relinquish class control. This new method is called lecture based tutoring. Lecture based tutoring still maintains student participation in the classroom, but treats the discussion with the student as a one on one tutoring session with the remainder of the students being listeners.

This paper does not focus on how to be an effective tutor. Wood and Tanner (2012) provide an excellent discussion on successful techniques for tutors. Rather this paper focuses on how to teach a course in a tutoring style rather than in a tradition lecture or a different active learning method.

The remainder of the paper is organized as follows. The next section provides the guidelines, rules and an application of lecture based tutoring. Some benefits of this new method are presented in section 3. The final section draws some conclusions and provides topics for additional research.

## **2. Lecture Based Tutoring Methodology**

This section describes how to implement lecture based tutoring. There are many different methods to implement lecture based tutoring, but these methods must conform to certain rules. The primary guidelines require that every student in the class be asked an individual question at least once a week. If the students responds correctly, the teacher may move on or emphasize critical points. If the students responds incorrectly, the instructor individually tutors the student to a correct response. The entire class must hear the student's responses and the teacher's tutoring.

Some may question and hesitate about asking a question to every student in the class. Every instructor knows that some students wish to speak in class all the time and others would prefer to be silent. When instructors ask a generic question to the class, typically zero to only a handful of students will answer the questions throughout the entire semester. Thus, if even a single student is not asked a question during the class, then not answering a question becomes a possibility for every student in the class. Consequently other students will ask not to be asked a question and the class eventually result in only a few students answering questions.

When responding to the question, it is critical that the instructor does not relinquish control of the class to the student. To emphasize this point, consider a class where a student moves to the front of the class to work a problem on the board. In this case, the student becomes the teacher as the instructor steps aside. The instructor has relinquished power and some authority to this student. This situation becomes worse when the student answers the question incorrectly or even inappropriately. Now the instructor must correct the student in front of the entire class with the student's weakness being front and center. When answering a question, the student should remain in his or her seat.

If the student answered the question correctly, the instructor can move to the next question. Alternately, the instructor may probe the student's response with the intent of the class learning the student's thought process. If accomplished correctly, the entire class may learn the student's viewpoint. Occasionally the student's answer is correct, but is too short. The instructor should agree with the student's answer and provide additional clarification or theory.

If the student did not obtain a correct answer, the instructor should tutor the student. The instructor should focus on the student. Questions from other students should be politely postponed until the tutoring session is completed. Once the tutoring is completed, the instructor should return to the other students' questions and answer those questions if these alternate questions have not already been answered.

The student's incorrect response provides the instructor with information regarding where the student is lost or confused. Using this knowledge, the instructor can determine the best method to correct the student's error. Fundamentally, the instructor should help the student obtain a correct answer to the question and this is done similar to an individual tutoring session. Short questions are asked and the problem is worked through slowly with substantial opportunities to verify the student's comprehension. This discussion should be similar to how one would answer the question if the student were alone in the instructor's office.

### ***2.1 Implementing Lecture Based Tutoring***

Implementing lecture based tutoring may seem daunting and this section provides a sample implementation. The class used for this example is a junior/senior level simulation course in the Industrial and Manufacturing Systems Engineering department at Kansas State University. The class has substantial modeling, computer programming and statistical analysis. Thus, many questions asked have a single correct answer that can be derived mathematically. Other questions have many potential answers.

The instructor for this class created a stack of 3 by 5 cards with each student's name and a picture. The instructor asks a question to the student whose name is on the top card and this card is placed at the bottom of the pile. These cards provide randomness and ensure that each student is asked an equal number of questions during the semester. The students quickly learn the names before his or her card and know when to pay more attention. Therefore, the instructor occasionally shuffles the cards during the semester.

The type of questions asked are critical. If the question is quantitative in nature, then the instructor explains the assumptions of the problem. It is imperative that the questions have short answers or too much control is given to the student. Common questions include:

“How would you approach this problem?”

“What is the first step?”

“What is the next step?”

“Please perform this step?”

“What are the underlying theoretical principles behind the methodology?”

“Extend this basic result into a general theory?”

In asking questions, it is critical to foster a positive experience with failure. Asking numerous questions per class diminishes the impact of an incorrect response. In each class, 20-

60 questions are asked per hour. The rate of questions is so rapid that students rapidly forget the individual that gave an incorrect response, which diminishes the impact of a poor answer.

Another method to encourage failure occurs when the instructor asks extremely complex research or graduate level questions. When a student cannot answer, the instructor turns the question to the entire class. The hope is that occasionally no one in the class will be able to respond. In such a situation, failure is acceptable as no one had the correct answer. It is even beneficial for the instructor not to know the answer. At this point, the material has become the master and both students and teacher become pitted against the material. Thus, even the instructor has failed to answer a question. Making failure acceptable is critical for a successful implementation of lecture based tutoring.

## ***2.2 Concerns and Dangers of Lecture Based Tutoring***

As with any method there are techniques to aid with an implementation of lecture based tutoring. This section describes various concerns, traps and pitfalls that could diminish the impact of this method.

A primary concern from faculty is the pace of the course. Numerous students responding should decrease the material covered. Surprisingly, the instructor has discovered the opposite. In a semester long course, at least the same amount of material was covered with lecture based tutoring as was cover with a lecture based format. The primary difference is that each example takes slightly longer with lecture based tutoring. However, fewer example problems are required as student understanding increases. Additionally, the students have fewer additional questions after the problem is completed. Thus, the same amount of material and possibly more can be covered with lecture based tutoring.

One problem occurs when a talented student answers a question and happily continues solving the problem. In such a situation, the student may complete an entire problem rapidly and less intelligent students may remain confused. It is critical for the instructor to congratulate the student and to cut the student off before the student goes too far. The instructor's common response could be "Excellent answer and it is exactly correct. However, you are beginning to answer my next question, which is intended for Dave." The attention now switches to Dave as he tries to answer the question. This helps to slow the presentation of the solution so there is more class comprehension.

Occasionally, several smart students are asked consecutive questions. In such a situation, the instructor has moved too quickly through an example. The instructor must back up and assure that there is adequate coverage of material. Asking the entire class if anyone is confused can help to provide additional discussion.

Another common trap occurs when the student being questioned either has been asleep or was not paying attention. If the person is catching up on sleep, the author asks the person sitting next to the individual to wake the person and thanks the student for being present in the class. In either situation, a brief summary is provided and the question is repeated. The answer is usually not stellar, which results in a bad answer. Correctly handling a poor answer is the most critical skill required by someone implementing lecture based tutoring.

The most common incorrect answer is "I have no idea" or "I am completely lost." The instructor must be prepared for many of these responses. Questions such as "Where should we start?", "The method starts by doing the following step and how do you perform this step?" If

the student still cannot successfully answers these questions, the instructor provides a partial answer. The student is again asked a question to determine if he or she can complete the remainder of the question. The instructor continues to provide partial answers with additional questions until the answer is obtained. If the student does not understand, the instructor should not badger the student. In most instances, the instructor should ask a question to the next student after a few questions to the confused student.

At times, a student may not understand the concept and the student asks clarifying question after question. The instructor feels that the vast majority of the class understands the concept and the class should move on to the next topic. It is important not to diminish the entire class's learning and material covered to cater to an extremely small number of students. The instructor should provide a polite comment that the class must move on and the student is encouraged to visit with the instructor during office hours to obtain additional detail and information.

Quiet students and individuals with thick accents are difficult to understand. Clarifying questions such as "Can you explain in more detail?", "What did you mean?", and "I am sorry, I couldn't hear your response." are typically asked. Another such question rarely comes off well and the instructor must focus on hearing and understanding the response. Repeating the student's response is critical for the entire class to understand the student's response. One must maintain the respect for the person's comment in repeating the student's answer and emphasis should not be put on the student's inability to speak loudly.

Rarely a student provides an unethical response. Such a response may be a derogatory comment about a person, gender, race, or involve inappropriate language. The instructor must be prepared to defend the classroom. Statements such as "The class and I do not support your viewpoint and would appreciate if demeaning comments are kept to yourself in this class. I would be happy to discuss this further with you after class." It is important to have a discussion with this student prior to the next class. In the two instances when the author has encountered such a situation, both students were attempting to be funny and the students never had a problem again. It was important to meet with the students after class to discuss the importance of their participation in class and to provide guidelines for proper classroom etiquette.

### **3. Analysis and Benefits of Lecture Based Tutoring**

This section provides some analysis of the impact on student satisfaction of a course. The primary measure for success is the student ratings of the teacher. The section concludes with some observed, but unmeasured, benefits of lecture based tutoring.

The author has taught 11 sections of IMSE 643, Industrial Simulation. Two sections used a lecture based format and nine implemented lecture based tutoring. No other substantial changes occurred in the class. Thus, the only change is the delivery style of the material.

The lecture based sections had an average class size of 16 and the lecture based tutoring sections have an average size of 22. Table 1 has the primary measures as reported on the IDEA [2] form survey for these courses. As one can see, the average excellence of teacher rating is 4.05 for the lecture based and 4.8 for the lecture based tutoring. The 4.05 rating is below the national average and the 4.8 is over the 80<sup>th</sup> percentile. This dramatic increase in student satisfaction with the level of instruction is solely attributed to lecture based tutoring style.

With only a limited amount of data, the 95% confidence interval of the lecture based tutoring is [4.67, 4.93]. Thus, a statistical test with null hypothesis that the mean of the student ratings score for the lecture based tutoring is equal to 4.05 is rejected with 95% confidence. Furthermore, the  $p$  value is less than .001. Consequently, there is a statistically significant difference in the excellence of the instructor, based upon student opinion, between a lecture format and a lecture based tutoring style. Thus, it can be stated that the students are far happier with a lecture based tutoring delivery.

**Table 1:** Student evaluations of the excellence of the teacher using IDEA forms.

Class	Lecture	Lecture Based Tutoring
1	3.8	4.9
2	4.3	4.9
3		4.4
4		4.8
5		4.9
6		4.7
7		4.8
8		4.9
9		4.9
<b>Average</b>	<b>4.05</b>	<b>4.8</b>

The author has observed many benefits of lecture based tutoring. One of the largest benefits is after a few weeks, students feel comfortable asking questions and stating when they are confused. Even when a student answers a question correctly, another student may state that he or she did not understand. The instructor can then tutor the confused student to the correct answer. The assumption is that other students in the class are also confused and the time is well spent.

Another benefit is that the students appear to gain more knowledge in the classroom. Surprisingly, few students attend the author's office hours. The author concludes that the students gained sufficient understanding from the lecture based tutoring class time to do the homework problems and perform well on the exams.

One of the author's primary benefits of this method is the chaos that occurs from a student answering a question. The same class is never an identical repeat. The instructor must remain alert and be willing to change the order of the topics covered to best accommodate the students' responses. Some responses are hilarious and others have led to research topics. The randomness provided by the students make each unique course and lecture different, which avoids teacher burnout on frequently taught courses.

#### **4. Conclusions and Future Research**

To the best of the author's knowledge, lecture based tutoring is a new active learning technique. This paper provided the general framework for this method. A sample implementation along with common pitfalls and problems are described. Data demonstrates the students rated the instructor statistically higher with this method as opposed to a standard lecture course.

There remains ample research to be accomplished in this area. This research should focus on providing answers to several research questions. Such questions include “Do students learn more material with lecture based tutoring?”, “What type of questions work best for lecture based tutoring?”, and “Are there better methods to perform tutoring during a lecture?”

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