

Application of Just-in-Time Teaching to a Large Physics Class

Michael DeAntonio
Department of Physics
mdeanton@nmsu.edu

Abstract

This article will present the benefits and difficulties associated with a particular teaching technique, Just-in-Time Teaching, as experienced by a typical instructor in physics. The main emphasis in the class was on the use of pre-class “reading assignments” based on the textbook reading and web content. The outcome of these assignments was then used to set the content for the lecture. This technique led to an increase in course content while enabling both students and the instructor the ability to handle the extra material.

Introduction

Just-in-Time Teaching is a technique that moves toward a more directed learning environment. It consists of two parts: active learning in the classroom and internet components that enhance the classroom learning experience.¹ In using this technique for the last year, I have experienced the typical rewards and difficulties that a professor might experience when building a new technique into the classroom.

The Design

In the case study presented here, the classroom was a 128 seat stadium style lecture hall with two projectors and a blackboard. A large table at the front of the room also provided adequate space for demonstrations.

Outside the classroom, students were instructed to login to a WebCT site which had a schedule and a table of contents (either of which would lead them to the course content). The content was divided into lectures and the students were provided with one or more of the following for each lecture: 1) handouts (Adobe Acrobat) for the PowerPoint slides that were used as part of the lecture, 2) the actual PowerPoint slides used in class, 3) a link to WebAssign (an internet tool where homework and “reading assignments” were completed), 4) a summary of the lecture, 5) the assigned reading material and links to other web-based material, 6) learning objectives for the lecture.

Other materials in the WebCT site were a syllabus, a message board, a chatroom, and a links download both Acrobat and PowerPoint viewers.

The students were given a “reading assignment” after each lecture. The reading assignments were worth 10% of the class grade. This assignment required them to read

the assigned pages of text for the next lecture and peruse the web-based materials which were hyperlinked with the reading. The reading assignments were due at 7:00am on the day of the lecture and the instructor reviewed the scores at that time. Class started at 8:30am. Thus, the instructor had 1 ½ hours to change the style and structure of the lecture.

The Questions

Typical questions in the reading assignment ranged from true-and-false to simple mathematical problems. The goal was to determine if the students had comprehended the material simply by reading in advance. Their level of comprehension for a particular topic would then dictate the style and content of the lecture.

The level of the questions varied depending on the instructor's understanding of the students needs and would consist of one or more of the following: 1) "look-up-in-the-book" fill-in-the-blank questions, 2) true-and-false, multiple choice or multiple selection conceptual questions, 3) conceptual essay questions, 4) simple numerical problems that test the use of a fundamental equation or concept.

The students were given a different number of attempts for each question. Fill-in-the-blank and true-and-false questions were set for one attempt. The others varied according to complexity.

The Lecture

The lecture was centered on a set of PowerPoint slides generated by the instructor. The slides included key concepts, equations and sometimes examples. Also included were animations created by the instructor to aid the student in the cognitive process. Beyond the PowerPoint, the students were given quizzes on the material from previous lectures. Demonstrations were also presented to enable the students to see the connection of the material to the real-world.

The lecture notes were developed in such a way that slides could be rearranged or deleted just before the lecture. New slides were often added to enhance understanding of a concept that was shown to be deficient in the reading assignment. Determination as to whether and which demonstrations were used in the lecture would also depend on the outcome of the reading assignments. Standard conceptual lectures, examples, pier learning and other techniques were often used interchangeably.

Results

JITT worked well in most respects, but took time to build into the class. The best outcome of the technique was that more material could be presented during the semester without sacrificing clarity. The biggest difficulty was in creating and finding the questions for the reading assignment.

Positive Outcomes

It would seem at first that JITT would increase the grade average of the class. After all, the technique is a good way to get them to use the textbook and they come more prepared for class. This did not happen in the test case. Instead, the grades remained roughly equivalent to the classes taught by the same professor without JITT. What did occur was that the instructor was able to cover more material in the class using JITT. About one full chapter was covered that was not covered previously.

The reason for this is not immediately apparent and has to do with teaching style. Although the students came better prepared for class and were more prepared to help each other with the material, the JITT technique allowed the teacher to teach less. The concepts learned by the students through their reading were de-emphasized and more advanced topics were covered. In essence, a large part of the time, the students demonstrated the ability to understand simple concepts on their own.

As an example, the instructor normally spends one to two lectures reviewing the different kinds of forces, how to identify them and how to determine their magnitude and direction. With JITT, the students in this class were able to see these concepts by viewing a simple table with the columns of force name, force symbol, how to determine if the force is present, magnitude and direction. Along with several examples of how to use the table, this was all the students needed. The table and examples were presented before class on the web and the students tested on the concepts in a “reading assignment”. 90% of the students understood the concept and the instructor felt comfortable moving on to free-body diagrams and conservative forces (two subjects where the students demonstrated a lack of understanding in their reading assignment).

Another positive outcome is the ability of the instructor to present more types material to the students. It was the variety of material that was most rewarding. From rank-order testing to animated presentations, to several points-of-view using other’s websites, the instructor was able to point students toward many different styles and forms of explanation. The students were willing to put in the time since 10% of their grade depended on it. This meant that, without using valuable lecture time, the instructor was able to present more types of material.

Negative Outcomes

The most difficult aspect of JITT is the need for the instructor to create or find questions that indicate whether the student understands the written and electronic material without detracting from the student’s confidence. The “reading assignment” should be made a reasonably small portion of the overall grade and it should be made clear to the students that a lower grade on the “reading assignment” versus homework, quizzes and exams is expected. The instructor found that it was helpful during class to show students histograms of their grades as the course progressed and make positive comments even on the lowest grades.

The most frequent comment on student evaluations for this instructor was that “the course was a lot of work”. This leads to another negative aspect of JITT. It increases the workload of the student. The instructor found that to keep the workload within reasonable levels the amount of homework and number of quizzes had to be balanced with the “reading assignments”. The students were found to be able to handle about 30 questions/problems per week in both the homework and reading assignments. It is also interesting to note that students frequently followed the “lot of work” comment with “but I learned a lot”. These students usually ranked the course and the instructor high among others within the department even if they felt overworked.

Lessons Learned

The instructor for the course will be making several changes to enhance the use of JITT in future classes. First, the instructor will be adding “hints” to the reading assignment questions and using a decreasing grade per attempt in order to allow students to be able to review the material until the question can be answered. In this way, the instructor can move away from simple true-and-false questions and probe more deeply through the more revealing rank-order, multiple selection and numerical questions.

Second, the instructor will be adding another component of JITT to the classroom by enhancing the peer learning aspect and moving to a question/answer format versus a standard lecture style in the classroom.

Finally, over the course of the next semester the instructor will be working with a committee of fellow instructors, graduate students interested in new teaching approaches, and undergraduate students who have previously taken the classes that will be taught using these methods. The committee will be meeting on a monthly basis to review and comment upon style and form of the various aspects of the class.

¹ G. M. Novak, E.T. Patterson, A.D. Garvin, W. Christian, Just-in-Time Teaching: Blending Active Learning with Web Technology, Prentice Hall, NJ, 1999.