

WHAT WORKS - A PEDAGOGY

JUST-IN-TIME TEACHING

Just-in-Time Teaching asks the question: "How can the web, a new tool, help students take more responsibility for their learning under mindful expert supervision?"

College teaching has been enhanced by the shift from what the teacher does-- primarily lecturing and presentation skills--to what the student does (Barr & Tagg, 1995).

JiTT was developed over the last fifteen years to encourage active student inquiry-based learning through harnessing the electronic technologies in the service of teaching and learning.

Just-in-Time Teaching is based on factors tracked in records of thousands of students on SAT/ACT, GRE, MCAT, LSAT, NTE, and retention in college. Astin, (1993) identified three main factors that when increased, enhance student learning: student interaction with faculty, the amount of time devoted to study outside of class, and the student interactions with peers.

Designing ways to use technology to promote learning is a good fit for the "millennial generation" (Howe & Strauss, 2000), students born in 1982 or after, for whom computing is ubiquitous. By examining which learning strategies most enhance learning and which technologies best support those forms of learning, technology can be harnessed not just for technology's sake, but to promote specific learning goals (Ehrmann, 1995). Tests and grades are gross measures of student learning. Angelo and Cross' Classroom Assessment Techniques (1993) offer faculty more systematic ways to collect and refine feedback about how students respond to specific learning activities and provide students feedback on their development as learners.

Although Just-in-Time Teaching makes heavy use of the web, it is not to be confused with either distance learning (DL) or with computer-aided instruction (CAI.) Most JiTT instruction occurs in a classroom with human instructors. The web materials, added as a pedagogical resource, act primarily as a communication tool and secondarily as content provider and organizer. JiTT is also not an attempt to 'process' large numbers of students by employing computers to do massive grading jobs.

JiT web pages fall into three major categories:

1. Student assignments in preparation for the classroom activity. WarmUps and Puzzles.
2. Enrichment pages. Short essays on practical, everyday applications of the course subject matter, peppered with URLs to interesting material on the web. These essays have proven themselves to be an important motivating factor in introductory service courses. Students learn better when they know when, where, and why they will use the knowledge they are learning (Bransford, et al., 2000).

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Using these factors as a framework, the Just-in-Time Teaching strategy pursues three major goals:

1. To maximize the efficacy of the classroom session, where faculty interact with students.
2. To structure the out-of-class time for maximum learning benefit.
3. To create and sustain peer interactions. Students work as a team (with instructors as coaches) to help all students pass the course with the maximum amount of retainable knowledge.

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3. Stand alone instructional material, such as simulation programs and spreadsheet exercises.

WarmUps and Puzzles are the heart of the JiTT web component. These are short, web-based assignments, which demand a great deal of thinking on the part of students because they must read and understand concepts in the text in order to submit brief answers. Giving students the chance to grapple with specific, relevant material prior to a lecture enables them to learn more from the lecture (Bransford, et al., 2000). The students are expected to develop the answer as far as they can on their own. We finish the job in the classroom. These assignments are due just a few hours before class time. The responses are delivered to the instructor electronically to form the framework for the classroom activities that follow. Typically, the instructor duplicates sample responses on transparencies and takes them to class. The interactive classroom session, built around these responses, replaces the traditional lecture.

Students complete the WarmUp assignments before they receive any formal instruction on a particular topic. They earn credit for answering a question, substantiated by prior knowledge and what they glean from the textbook. The answers do not have to be complete. In fact, partially correct responses are particularly useful as classroom discussion fodder.

The educational construct known as "time on task" holds that increased study time increases student learning. Out-of-class assignments increase student study time and structure student learning. Setting high but reachable goals for student performance increases student achievement for both well- and poorly-prepared and motivated students. One way to set high expectations is to demand serious effort on out-of-class assignments.

In contrast to WarmUps, Puzzle exercises are assigned to students after they have received formal instruction on a particular topic. The Puzzles serve as the framework for a wrap-up session on a particular topic.

The WarmUps, and to some extent the Puzzles, target a variety of specific issues. In physics, for example, the list of targeted issues might contain: developing concepts and vocabulary, modeling -- connecting concepts and equations, estimation- getting a feel for magnitudes, relating physics statements to "common sense", and understanding equations - the scope of applicability.

JiTT's on-going feedback loop provides the instructor with a fairly detailed profile of the student audience, both as a group and as a collection of individual human beings with special needs. The resulting classroom experience gives the students the comfortable feeling that the instructor is aware of their mental state and their needs as they unfold through the semester. While, in

principle, this kind of information could be collected on paper, the process would not be as effective. The space and time barriers involved (when do you collect the paper submissions and where) would be frustrating. Just as a phone conversation is more immediate than a letter, bringing to class students' responses while they are still warm creates a dialog atmosphere where each student can feel that they own a part of the lesson. All of this feedback, including the not infrequent email exchange after class enhances student learning by creating closer student-instructor interactions.

From the instructor's point of view, the lesson content remains pretty much the same from semester to semester with only minor shifts in emphasis. From the students' perspective, however, the lessons are always fresh and interesting, with a lot of input from the class. We have conducted numerous surveys looking for cognitive as well affective outcomes. It is clear from students' comments that they consider the electronic exchanges intimate and personal. Most JiTT pages contain a space for students' thoughts and concerns. The concerns are addressed in class to everyone's benefit and they are often followed by multiple email exchanges between the instructor and the student who raised the issue, occasionally followed by a personal visit in the instructor's office. These sentiments are echoed by a large number of JiTT adopters, many of whom consider the enhanced personal interaction with their students one of the primary reasons to adopt the JiTT pedagogy.



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The JiTT classroom session is intimately linked to the electronic preparatory assignments the students complete outside of class. Exactly how the classroom time is spent depends on a variety of issues such as class size, classroom facilities, and student and instructor personalities. Mini-lectures (10 min max) are often interspersed with demos, classroom discussion, worksheet exercises, and even hands-on mini-labs. Regardless, the common key is that the classroom component, whether interactive lecture or student activities, is informed by an analysis of various student responses.

In order to engage students during class, lectures are punctuated with periodic activities to reset the attention clock for students, as well as allow them to practice using new concepts, enhancing storage and retrieval of information. (Middendorf & Kalish, 1996) Active learning exercises can consist of any of a variety of individual or collaborative activities.

In a JiTT classroom students construct the same content as in a passive lecture with two important added benefits. First, having completed the web assignment very recently, they enter the classroom ready to actively engage in the activities. Secondly, they have a feeling of ownership since the interactive lesson is based on their own wording and understanding of the relevant issues.

The most exciting development in the JiTT community is the recent (September 2003) NSF grant award to establish a digital library of JiTT resources under the NSF NSDL (National Science Digital Library) umbrella. The three year, \$850,000, project will strengthen the JiTT community in many ways. The library of resources will employ a user-contributor model, along the lines of open source initiatives. Instructors will modify and enrich one another's materials and teaching tactics. The library collection will contain not just curricular material such as WarmUps and ancillary items such as images, demos, and videos, but also student responses and classroom tactics invented by instructors to deal with these responses. In addition there will be "meta-items" such as references to the scholarly articles and books relevant to JiTT, as well as instructors experiences with the construction of JiTT assignments and classroom tactics. The retrieval of this information will be facilitated by a faceted (ref) metadata structure.

For more information on JiTT and for sample materials please visit www.jitt.org.

For the current status of the project please visit www.jittdl.org.

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