
BLOGS AND WIKIS AS INSTRUCTIONAL TOOLS

A SOCIAL SOFTWARE ADAPTATION OF JUST-IN-TIME TEACHING

Jude Higdon and Chad Topaz

Abstract. Just-in-Time Teaching (JiTT) methodology uses Web-based tools to gather student responses to questions on preclass reading assignments. However, the technological requirements of JiTT and the content-specific nature of the questions may prevent some instructors from implementing it. Our own JiTT implementation uses publicly and freely available Web 2.0 technologies such as blogs and wikis and discipline-neutral preclass questions. Our approach helps to foster deep, conceptual understanding of course material while helping to create learning environments that align with Bransford et al's (2000) four "centrisms" that describe successful learning environments.

Keywords: *blog, Just-in-Time Teaching, learner, Web 2.0, wiki*

Do our college students learn what really counts? One well-documented answer to this fundamental question comes from the physics community (Halloun and Hestenes 1985). Postsecondary physics instruction, and consequently students' intellectual energies in physics classes, has historically centered on the

mechanics of the discipline in service of exam preparation rather than on a deep conceptual understanding of physical laws, what they mean, and their thoughtful application to a variety of real-world problems (Mazur 1997). Over the past ten years, this problem has received close attention, leading to the development of novel pedagogies such as Just-in-Time Teaching (JiTT; Novak et al. 1999) and peer instruction (Mazur 1997). Instructors in other disciplines, recognizing the historical curricular overemphasis of basic factual and procedural knowledge, have

endeavored to implement these pedagogical techniques closer to home, with greater and lesser degrees of success.

In parallel to these pedagogical advances, the recent emergence of Web-based communications tools has changed the way we approach the tasks of producing and consuming information. One part of this revolution has been the advent of social software technologies including blogs, which have found a strong foothold in academia (Downes 2004; Glenn 2003).

The convergence of these technological and pedagogical developments has created new, synergetic possibilities to help our students learn better. In this vein, we have created an adaptation of the JiTT framework that uses freely available social software tools, namely blogs, wikis, and RSS aggregation. We developed this methodology to help address our central goal for our students: to promote deep, conceptual understanding of core course material that would be transferable to contexts outside of the classroom. As we will describe, our Just-in-Time Blogging also supports the four "centrisms" of constructive learning environments (Bransford et al. 2000). Although we developed Just-in-Time Blogging in the context of mathematics classes at small liberal arts colleges and large research universities, nothing about it is discipline specific. It can be equally applied, without modification, to courses in many other fields and at institutions with a wide range of technical capacities.

*Jude Higdon is the managing director of the Technology Enhanced Learning group at the University of Minnesota's College of Liberal Arts. Chad Topaz is an assistant professor of mathematics at Macalester College in St. Paul.
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Just-In-Time Blogging Methodology

To address our instructional goal and objectives (which we discuss in detail below), we have developed a Just-in-Time Blogging approach adapted from the JiTT methodology (Novak et al. 1999). In brief, JiTT is an instructional practice in which instructors use preclass assignments to gauge student understanding of course concepts. Classroom activities, including lectures, are altered “just in time” to address specific gaps in student understanding. In practice, our version of the JiTT methodology involves three basic steps:

1. The night before each face-to-face class meeting, students briefly respond to the following two questions:
 - “What is the most difficult part of the material we will discuss in tomorrow’s class?”
 - “What is the most interesting part of the material?” or “How does the material connect to something else you have learned in this field or another field?” or “How is this material useful/relevant to your intellectual or career interests?”
2. Just prior to class, the instructor scans students’ responses to identify common themes and areas of difficulty and grades the responses based on an established, public rubric.
3. The instructor adjusts the allocation of classroom time to address the areas specifically identified by the students as being problematic.

The technical requirements of Novak et al.’s classic JiTT pedagogy are appreciable. Implementation requires both a system that allows students to submit responses and a mechanism by which instructors can easily aggregate and scan student responses. In our experience, many colleges and universities are not ready to support JiTT-based activities with development and support resources for such systems. Fortunately, the advent of enterprise-level, publicly available Web 2.0 technologies makes such development and support unnecessary and perhaps even redundant. To enable student participation in the preclass journaling activities, we use a combination of social software tools, namely blogs (e.g., blogger.com), wikis (e.g., jotspot.com) and RSS syndication

(e.g., rss-to-javascript.com), a technology that enables blog entries from multiple sources to be aggregated into a single digital location. From a technical viewpoint, our approach involves the following steps:

1. Students create a blog on blogger.com (or any other public blogging environment) at the beginning of the semester. Each student e-mails the instructor the link to the blog’s RSS feed.
2. The instructor creates a wiki. This is not strictly necessary, as nearly any Web site will work. Course management systems such as Blackboard or WebCT could be used, for example, as could a plain HTML Web page, but wikis generally make syndicating student RSS feeds from blogs fairly simple.
3. The instructor syndicates all of the students’ feeds into the wiki (or Web page) using an RSS aggregation tool. This can be completed with an initial setup of approximately one minute per student.
4. Students blog their responses to the two questions by a predetermined deadline (we choose midnight the night before each lecture).
5. The instructor scans and grades the aggregated feeds from a single page on her or his wiki that automatically updates when students submit new posts on their individual blogs. Thanks to the aggregation, the instructor is saved from visiting a different blog page for each student.

On a tactical level, our approach differs from Novak et al.’s approach in three key ways. First, the questions that we ask are not discipline specific. Second, we do not change the questions to be content specific for each lecture, as Novak et al. does. The onus is placed on students to demonstrate that they have completed the preclass readings and can identify what was difficult and interesting for them personally. Third, the technology that we use for preclass exercises relies, as mentioned, only on publicly available tools rather than specialized, locally developed and supported systems.

Common Questions and Concerns

Instructors with whom we share the Just-in-Time Blogging methodology typically

have some initial questions and concerns, including the amount of time it will take, the difficulty of the technological implementation, and the willingness and ability of students to adhere to the assignment.

I don’t have the technical computer skills necessary to use this method. If you have the ability to set up a simple Web page, you have sufficient skills to use the social software tools we have suggested (or similar ones). Sample HTML code can be downloaded from our Web site at <http://web.mac.com/chad.topaz/ChadTopaz/blogging.html>.

My students won’t do the assignment. Make the blog assignments a significant part of the course grade so that students take it seriously. We believe that students will spend trivial time and effort on activities that we require them to do for a trivial part of the grade, but that they will prioritize and make an effortful attempt at activities that we value enough to make a significant part of the grade. If you don’t value the activity, they won’t either.

My students won’t provide useful blog responses. Students need training to become familiar with the Just-in-Time Blogging methodology, which they will likely find unfamiliar. They also need experience answering the “most difficult” question in a manner that is specific enough for you to address in class. For instance, for a calculus reading assignment on differentiation, “I don’t understand derivatives” is quite broad. “I don’t understand how to apply the limit definition of the derivative to a particular function” or “I don’t understand how the book gets from equation three to equation four” is more helpful because these statements are focused and actionable. Tell your students that the first three blog assignments are for practice and will be ungraded. After that, provide them with (anonymous) examples of responses you found to be excellent so that they have models to work from. Provide ongoing feedback that incentivizes good responses early on to get them in the habit of writing useful blog entries.

My students will insist that nothing about the reading is difficult. Some students, either honestly or falsely, will inevitably claim that nothing challenges them. Advise your students that this response is unacceptable, and provide the following

two options: think more deeply about the material to find something genuinely challenging, or modify the question to be “What do you think the most difficult part of the material was for most students in the class?” We have taught a wide range of students, from nontraditional adult learners returning for their bachelor’s degree to thirteen-year-old math prodigies; we have yet to encounter a student who was unable to write a compelling blog entry for any reading.

My students will not be able to reflect on the material. Encourage students to use the second portion of the blog response to connect the material to their life outside of your course. Our favorite responses to the second (reflective) part of the assignment are those in which students connect the material to closely-related courses, to courses outside of the discipline, or to their lives outside of the classroom altogether. Encourage this type of response, and even be willing to ask students to share their responses during class. Tell your students that connecting this course to the rest of their academic, professional, and personal lives is one of your goals for them.

I don’t have enough time to read and grade student responses. Reasonable student responses can be read in less than a minute per student. If that is too time intensive, manage your class size and don’t overburden yourself. For large classes, read one-third or one-quarter of the students’ preclass responses each time—just don’t tell students when their assignments will be graded to maximize participation. If teaching assistants are available, divide the blog reading up among them, and have them pass an executive summary to you before class. It can also help to create a simple grading rubric and share it with your students. One possibility is the following zero-to-three-point scale:

- 3: Both questions answered, and “most difficult” part is specific and actionable.
- 2: “Most difficult” part is not specific/actionable and/or only one of the two questions has been completed.
- 1: Blog posting does not demonstrate that reading has been completed.
- 0: Blog posting not completed on time.

With a simple scale like this, a typical blog entry can be read and graded in less than one minute.

I don’t have enough time to alter my lecture notes and lecture plan. You don’t need to. Jot notes as necessary while you scan the aggregated blog responses, and simply change how much time you spend on each part of your lecture to better address the difficulties stated by your students. If you wish, you can save the notes you jot and retool your lectures at another time (for instance, during interterm).

Also germane to our methodology are four different types of knowledge: factual (discrete, isolated knowledge), procedural (steps or processes of how to do things), conceptual (sophisticated schemas and aggregations of facts and procedures), and metacognitive (knowledge of cognition and one’s own ability to regulate cognition; Anderson and Krathwohl 2001).

With these knowledge types and centrism in mind, we have developed a set of five instructional objectives in sup-

WITH THESE KNOWLEDGE TYPES AND CENTRISMS IN MIND, WE HAVE DEVELOPED A SET OF FIVE INSTRUCTIONAL OBJECTIVES IN SUPPORT OF OUR PRIMARY GOAL: TO PROMOTE DEEP, CONCEPTUAL UNDERSTANDING OF CORE COURSE CONCEPTS.

Centrisms, Knowledge Types, and Instructional Goals

Our Just-in-Time Blogging methodology described above arises from a consideration of the four “centrisms” of constructive learning environments: learner-, knowledge-, assessment-, and community-centrism (Bransford et al. 2000). In brief, “learner-centered” describes a focus on learners’ individual preconceptions, misconceptions, cultural backgrounds, and personal biases and preferences. “Knowledge-centered” refers to a focus on disciplinary content from a rich, conceptual (as well as factual) perspective. “Assessment-centered” describes learning environments designed with ongoing, formative opportunities for students to get feedback on their understanding. Finally, “community-centered” refers to building opportunities for students to learn in a social context, collaborating with peers and learning as part of their class, their school community, and the world outside of the classroom. These centrism together help to create a holistic, positive, and effective environment for learning (Bransford et al. 2000).

port of our primary goal: to promote deep, conceptual understanding of core course concepts. This primary goal arose from a challenge we see in the field of mathematics. Whereas mathematicians generally see mathematics as a highly conceptual discipline, courses in postsecondary math typically feature a lecture-based format and a small number of high-stakes, computationally intensive examinations, focusing learning on factual and procedural knowledge. We want our students to develop these factual and procedural skills, but in service of a deeper conceptual understanding. We emphasize here that we use mathematics simply as an example; the same or similar challenges exist in other disciplines.

Our first instructional objective in service of this overall goal is to foster mastery-goal orientation among students, which promotes a community-centered environment. A mastery goal orientation indicates a focus on the underlying skills, principles, and strategies needed to complete a task or perform a function. In contrast, performance goal orientation indicates a focus on the outputs of a task, such as the grade that the student receives

on an assignment or her or his rank relative to others performing the task. (Dweck and Elliott 1983; Dweck and Leggett 1988; Nicholls 1984). The typical structure of postsecondary mathematics courses can drastically overpromote performance orientation relative to mastery orientation, and it is desirable to rectify this imbalance. Promoting a mastery goal orientation promotes a community-centered learning environment by developing students who are more willing to work with one another to iron out misunderstandings, to admit when they are struggling with an idea, and ultimately to raise the learning of the entire classroom community.

Our second instructional objective is to promote metacognitive reflection among our students, which supports knowledge-centrism. Traditional mathematics courses tend to neglect metacognitive knowledge, or “thinking about thinking” (Perkins 1987). While there are many dimensions of metacognitive knowledge, one aspect is the idea of “sense-making”—that is, stopping to determine if what you are learning actually makes sense, and, if not, strategizing for remediation. We refer to this process as “metacognitive reflection.” As metacognition is one of the four fundamental types of knowledge (Anderson and Krathwohl 2001) we see metacognitive reflection as a central dimension of knowledge-centric teaching.

Our third instructional objective is to promote active transfer of course concepts, which also supports a knowledge-centered environment. A common assumption among instructors is that the connections that they themselves make (and see as obvious) between the course content and applications in the “real world” are being made by students as well, even without overt curricular guidance. In truth, however, helping learners explicitly to connect what they are learning in class to the world outside of class can help to promote transfer to problems in future classes and to their lives outside of school altogether (Bransford et al. 2000).

Our fourth objective is to respond to individual differences among learners, a central dimension of a learner-centered environment (Alexander and Murphy 1997). In large and small lecture classes, it is often easiest to address the learning needs of outgoing, gregarious, confident students, but

harder to address the needs of those who are shy, quiet, or less confident. By giving voice to individual students in the class (for instance, by using technology) an instructor can overcome these challenges and design the class activities based on this information gleaned from all students, rather than on limited information or on a hunch about what is difficult about the material.

Our fifth and final instructional objective is to increase the amount of effortful time that students spend working with the material, providing increased opportunities for feedback and more time to learn. This is central to a productive assessment-centered environment. A classic problem in, for instance, the culture of mathematics instruction, is that the system “nods and winks” at students who do not complete preclass reading assignments and therefore see the material for the first time during class. This systemic failure to help motivate student learning through persistent, effortful exposure to the material is a clear target for improvement. Increasing (and incentivizing) the number of opportunities for students to think hard about the material and to conduct a “self-check” of their understanding greatly increases the amount of feedback that the student receives and results in a more assessment-centered environment.

Discussion

A quick survey connects our Just-in-Time Blogging methodology to our instructional objectives and to the four centrism of constructive learning environments (Bransford et al. 2000). The first blog question encourages students to focus on and articulate ways in which the material is challenging. We thus foster both a mastery goal orientation and metacognitive reflection, which in turn support community-centeredness and knowledge-centeredness. Our second question, which asks students to reflect on what they find interesting about the material or connect the material to something outside of the course, promotes active knowledge transfer and hence supports knowledge-centeredness as well. By reading and reacting to what students explicitly describe as being most difficult about the course material, we respond to individual differences among students, promoting a learner-centered environment. And by creating an accountability system that requires students to read course material and

self-assess prior to classroom meetings, we increase the amount of time that students are spending with course concepts and ultimately foster an assessment-centered environment.

We have quantifiable metrics demonstrating success toward three of our instructional goals: promoting metacognitive reflection, responding to individual differences among learners, and increasing effortful time. (For our remaining instructional objective and goals—promoting persistent conceptual understanding of the course material, fostering mastery goal orientation, and promoting active transfer of concepts—we have little in the way of data.) The data come from an undergraduate numerical analysis course taught during two distinct eleven-week terms from 2004–6, with $N = 40$ students and $N = 35$ students, respectively.

Our measure for the metacognitive objective is the percentage of blog entries that contained a formal moment of reflection on the course material. Our measure for the effortful time objective is the percentage of blog entries that demonstrated that the student had completed the preclass reading assignment. We operationalize both measures as the percent of blog entries that received a satisfactory grade (two points or three points) per the rubric described above.

The quantitative measures show remarkably high results: on average, students received a satisfactory grade—demonstrating metacognition and completion of the reading—86 percent ($N = 40$) and 90 percent ($N = 35$) of the time in preclass assessments. Our data also suggest that we achieved our goal of addressing individual differences among learners. We used the preclass reflective assignment to alter in-class activities for every course lecture; each of the over 30 class lecture periods per term was impacted by explicit student assertions of areas of difficulty or misconceptions.

Qualitative study of the blog entries and observations made during class confirm that the level and sophistication of discourse about the course concepts was markedly higher than it had been in courses that we taught prior to using this method. This is shown, for example, in the following blog entry that one student wrote after completing a reading assign-

ment on using the bisection method for finding roots of algebraic equations:

I think the hardest part of the reading had to do with the “tolerance level”. It took me a moment to figure out exactly how the formula for calculating tolerance related to the picture in my head. The diagram on page 47 helped sort things out. Also, I went back to my analysis class notes and looked at the proof for Bolzano’s Theorem. The proof took me a little while to digest—I guess I had forgotten how non-intuitive epsilon-delta proofs are. The bisection algorithm seems very similar to binary search in programming, which is of order $\log N$. I’m guessing we can apply other, more efficient search algorithms to the problem of finding a root between two specified numbers. I’m going to do some reading on other algorithms and will see if they apply.

The student first identifies a specific area of difficulty from the reading: the notion of tolerance (which has to do with the disparity that one is willing to “tolerate” between an approximate answer found through computational methods and the true, exact solution of a particular equation). Note that his discussion is conceptual, focusing on how the mathematical expression for tolerance connects to his own visualization of the idea. The student demonstrates additional metacognition by revisiting a difficulty from a previous mathematics class, namely the “non-intuitiveness” of epsilon-delta proofs. He then explicitly connects the course material to something learned in another field, namely binary searches in computer science. Finally, he even outlines a future learning task based on his own interest, namely to do further reading on the efficiency of root-finding algorithms.

Beyond qualitative observation, we do not at this time have quantitative data for the objectives pertaining to conceptual understanding, active transfer, and mastery goal orientation. Our future research plans include both a longitudinal study of retention of conceptual course material and a quasi-experimental study including the Patterns of Adaptive Learning Scales

(Anderman and Midgley 2002) to determine areas of success or opportunities for future improvement and refinement of our method based on these goals.

Conclusion

The JiTT methodology provided a new approach to teaching undergraduate physics; however, the technological requirements, along with the content-specific nature of the pre lecture questions, may have proven too large a hurdle to overcome at schools and in disciplines without the ability to develop systems to support the practice. Because our methodology uses enterprise, public Web 2.0 technologies, and a standardized approach to preclass questions, it can be used in a wide range of disciplines, with little technological overhead, and with minimal instructor load implications.

Ultimately, we feel confident that our Just-in-Time Blogging methodology has been helpful in achieving our stated instructional goals and objectives, including our highest-level goal regarding conceptual understanding. We return to the question posed at the start of this article: do students learn what is really important? We believe that they can, assuming that what we think is truly important is a deep conceptual understanding and the ability to transfer course concepts to other contexts. However, much depends on what we as instructors are willing to do to foster this type of learning. Future research will give us more information about the degree of success of our approach, and it will help us to make further adjustments to better meet the learning needs of our students.

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