Just In Time Teaching: What it is, how it looks, why it works...

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Abstract

“Just-in-Time Teaching (JiTT) uses Web-based materials to create a rapid feedback loop between students’ learning inside and outside the classroom”.¹ In a first year “Introduction to Business” course, quizzes were presented to students via the university’s learning management system to provide information to the professor about muddy concepts from the textbook for further discussion in the lecture which followed the day after the quiz closed. The JiTT approach described herein included YouTube videos to preface the quiz and tightened the linkage of the lecture content to the quiz material through this technique. Anecdotal evidence of success is provided.

Introduction

The term “Just-in-Time” is used in various contexts. For example:

- Just-in-Time manufacturing is an *efficiency* process that reduces inventory levels and work-in-process. E.g., automotive components arrive from their supplier at an automobile assembly plant ‘just in time’ for their inclusion into the rest of the car being assembled.

- Just-in-Time compilation is a computer science strategy for allowing “write once, run anywhere” computer code. E.g., machine-independent Java byte-code is compiled ‘just in time’ by a virtual machine into executable code specific to a particular processor.

These same notions can be applied to *teaching*, the resulting technique referred to as “Just-in-Time Teaching,” often shortened to the JiTT acronym. As Davis defines it, “Just-in-Time Teaching (JiTT) uses Web-based materials to create a rapid feedback loop between students’ learning inside and outside the classroom”.

Context

MGMT*1000—Introduction to Business—is a required first year, first term course for all students (nearly 800) in the Bachelor of Commerce (B.Comm.) degree at the University of Guelph. Within the B.Comm. stream there are a variety of different programs—traditional business school offerings like Accounting, Management Economics

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2 Davis, “Experiences with Just-In-Time,” 71.
and Finance, and Marketing Management, in addition to non-traditional specialized
programs like Food and Agricultural Business, Hotel and Food Administration, and Real
Estate and Housing. MGMT*1000 is a 1.0 credit course (versus the usual 0.5 credit) and is
delivered in a lecture / seminar format. The lectures are delivered by the professor (~400
students/lecture section for 1 hour/week), while the seminars are delivered by
Undergraduate Teaching Assistants (UTAs) (~40 students/seminar section for 2
hours/week). The JiTT approach of this paper was applied only in the lecture context.

Thus, the purpose of this paper is to describe the benefits (and drawbacks) of JiTT,
discuss how and when to implement this approach, and detail how JiTT was leveraged
successfully in the context of MGMT*1000. This paper will begin with a more detailed
description of JiTT than the one from Davis above:

“We introduced JiTT into our economics courses, requiring students to
answer questions related to upcoming class material a few hours before class
using an online course management system. The results were positive and
immediate. Students came to class better prepared and reported that the JiTT
exercises helped to focus and organize their out-of-class studying. In
addition, students’ responses to JiTT questions made gaps in their learning
visible to us prior to class. This knowledge allowed us to create classroom
activities that directly addressed those learning gaps while the material was
still fresh in students’ minds—hence the label “just in time”—leading to
improved learning.”

Figure 1 illustrates the ideas of Simkins and Maier as a four-stage process. This process is
described as “generic” since it is not bound by assumptions of which stages of the process
occur in the classroom or out of the class, the delivery mechanism of the assessment, and so
on.

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3 Scott Simkins and Mark Maier, eds., Just-in-Time Teaching: Across the Disciplines, and Across the Academy
(Sterling VA: Stylus Publishing LLC, 2009), xiii.
The stages of this process are as follows:

1. **The student prepares** the class material. This could be in the form of reading the textbook or working homework problems. Both Davis and Simkins and Maier refer to ‘out-of-class’ preparation, but this process is not restricted to the geographic and chronological boundaries of ‘in’ or ‘out’ of class—students could be asked to read a hand-out or work on a problem given in class and the process would still work.⁴

2. **The student completes an assessment.** This assessment could be formative (i.e., no marks involved) or summative (graded). Both the authors describe web-based, electronic delivery of the assessment instrument—this does not need to be the case. For example, a paper-based in-class quiz could be used in this capacity. A second example could be the use of a “classroom response system” (e.g., clickers or analogous devices) for completing the assessment shortly after it is given to the students.

3. **Lead time** refers to the time between the initiation and completion of a process—in this case, the time between the completion of the student assessment and the start of the customized classroom activity to meet the learning gap(s). The lead time

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includes the professor’s evaluation of the learning gap(s) from the assessment and preparation for the customized in-class learning activities. Simkins and Maier describe a lead time of a few hours; the lead time for MGMT*1000 was about two days. An in-class quiz leading to a change in lecture content could have a lead time of only a few minutes—truly “just in time”!

4. **Delivery** of the learning activities. As Davis describes, “the key idea is to adjust lesson plans “just-in-time” in response to students’ preliminary understandings of course concepts”. Thus the choice of learning activities or the focus of those activities is informed through the analysis of the gaps between learning objectives and assessment outcomes.

With this four-stage notion of the JiTT process described, this paper will examine how to transform a “traditional” classroom process into a JiTT process.

**Flipping the Classroom...**

Back in the day when many faculty members did their undergrad degrees, the learning pattern was simple and straightforward: come to class (with little or no preparation required), sit through a “stock” lecture (inasmuch as it wasn’t *customized* based on the knowledge or abilities or skills of the students). Sometime after that class (but before the next one), crack open the textbook, read about what was recently ‘taught’, and do the homework problems to test one’s abilities. Figure 2 illustrates this traditional teaching model. In order to transition from this ‘old school’ model of teaching to JiT Teaching, two transformations must take place:

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5 Simkins and Maier, *Just-in-Time.*
6 Davis, “Experiences with Just-In-Time,” 72.
- a classroom ‘flip’ and
- informing the lecture.

Figure 2: Comparing “Traditional” Teaching to Just-in-Time Teaching.

In an ideal world, students should have read the text in advance of the class. One criticism of JiTT is that instructors should not have to incent students with quiz marks to read the required materials in advance of the class—it should be a baseline expectation that students show up to class prepared. However, since this does not always happen, a small incentive mark for a quiz is leveraged to “Flip the Classroom.” Research has shown that JiTT does result in a higher probability of students coming to class prepared.\(^7\) Thus, students arrive at the lecture with the requisite material already read and their mastery of it assessed to some degree with the quiz. This point is reinforced with anecdotal evidence below.

As Simkins and Maier note, “an added benefit of JiTT exercises... is that they are completed out of class thus freeing up valuable, in-class instruction time for interactive lectures, hands-on activities, or collaborative problem-solving exercises”. In MGMT*1000, students are told in the very first lecture that the class time is better utilized integrating conceptual material together from previous lectures and applying it to problems found in the news than it is for the introduction of material they could read and review on their own. This notion of concept, integration, and application is expanded upon below.

It is worth re-iterating the words of Simkins and Maier, “students use JiTT more effectively if its purpose is explained clearly in advance, noting the importance of regular pre-class assignments... To be successful, JiTT exercises should be linked to important course learning outcomes and integrated into the course in an intentional manner”.

In the case of MGMT*1000, the Course Outline and the first lecture was used to introduce the concept of JiTT to the students. In much the same way that just-in-time manufacturing can be thought of as a “management philosophy”, just-in-time teaching must also fit within a pedagogical philosophy framework. The model used to describe the teaching of MGMT*1000 is the “C.I.A. Model” for (C)oncept, (I)ntegration, and (A)pplication and JiTT is congruent with this teaching and learning philosophy. Refer to Figure 3 for an illustration of this model.

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9 Simkins and Maier, Just-in-Time, xvi.
The model of Figure 3 was followed by this description from the MGMT*1000 Course Outline:

We have a lot of material to cover this term! Most of the basic concepts you can get from reading the textbook. Concepts that require some additional explanation will be covered with screen capture videos at CourseLink and YouTube. Quizzes will be done through CourseLink. The quizzes will close on the Saturday evening before Monday’s lecture. This is done for two reasons. First, it provides an incentive to ensure that the textbook reading actually occurs! Second, by looking at the quiz results, it allows me to update and tailor Monday’s lecture to cover off points that appear to be confusing or not well understood. This approach is called “Just In Time Teaching.” (MGMT*1000 Course Outline, Fall Term 2011).

Thus, the students are presented with the overarching pedagogical philosophy for the course and given a rationale for the JiTT approach—which they may not have seen prior to their first term in university. This reinforces the point that Simkins and Maier make about linking JiTT to course objectives. If your course objectives are incompatible
with the JiTT technique, forcing a JiTT "solution" on the classroom could result in undesirable or unintended classroom outcomes.

...and Informing the Lecture

Flipping the order of learning pattern blocks is the first step of just-in-time teaching. The second step is to use the quiz results to inform the lecture. If a particular quiz question or question area was not done very well, the lecturer can add additional material in the upcoming class to address this deficiency. If quiz questions were done very well, the lecturer can drop the material related to this content area and move into the integration and/or application of those concepts the students have demonstrated mastery over. Thus the time between when the quiz ends and the next lecture begins is used to customize the lecture based on the learning needs of the students as determined by the quiz results.

Tools & Technologies

Figure 4 shows a waterfall diagram with "swim lanes" to illustrate the tools and technologies used in MGMT*1000 to achieve a JiTT approach to this class. Admittedly, a JiTT approach requires a larger ‘front-end’ investment in preparation time than a traditional lecture, but there is a pay-off in terms of increased student engagement through their pre-lecture preparation and deeper learning happening in the lecture. Chapter summary videos and quizzes need to be developed in advance of the quiz window. While the bulk of the impending lecture can be completed in advance of the quiz results, it is never completely done until just before the lecture. That said, the next time the course is run, all of the quiz prep and YouTube videos\(^\text{10}\) are already done. Knowing what topics

\(^{10}\) [www.youtube.com/MGMT1000Videos](www.youtube.com/MGMT1000Videos)
caused confusion last time allows for ‘tweaking’ of video content to highlight areas to focus on next time the course is offered. There will always be concepts that are muddy and require additional ways of being presented—JiTT is a technique to identify those concepts.

Figure 4: JiTT Tools & Technologies

JiTT is a very flexible and extensible technique in many regards. In the case of MGMT*1000, Camtasia and YouTube were used to create and host content to augment the textbook material, but this didn’t have to be the case. The choices of content will vary by instructor. Some may choose to not create additional material, but stick with the textbook and publisher provided content (e.g., textbook student companion website). Others may wish to create additional content (e.g., Camtasia / YouTube) specific to the course learning objectives. A third approach is to “curate” existing third-party content (e.g., Khan Academy khanacademy.org) where applicable. The choice to use multiple-choice quizzes in the
CourseLink learning management system was made for ease of administration and quick feedback.

The choice of feedback technique is also open. Rather than a closed set of multiple-choice responses, some professors choose to use open-ended questions where “the teacher provides students with a slightly provocative and memorable statement that is open to a considerable amount of interpretation”.\(^{11}\) The MGMT*1000 JiTT lead time “window” was about 48 hours from the time the quiz closed Saturday night until the lecture on Monday evening. Novak and other authors talk about shorter lead times of hours—an assessment might be completed in the morning before an afternoon class. Whatever parameters an instructor chooses—content, assessment style, lead time, customized learning activity—make sure it works for your course objectives and teaching philosophy.

Just-in-Time Teaching in Action

The Devil (they say) is in the details. Consider these quiz results from the CourseLink learning management system:

Aggregate level:
Overall average on the quiz: 85.2%...

Detail level:
...BUT Question #9 wasn’t done so well.

At the aggregate level, and instructor might dismiss the quiz results—“the class did well; 85% overall average, no need to tweak the lecture.” However, upon drilling down into the data, less than half the class got the correct answer for question #9—aah! A teachable moment learning opportunity that can be incorporated into the next lecture!

The following four slides illustrate the approach taken in MGMT*1000 to share the quiz results and address the poorly done question with the class:

1. The discussion of the quiz from the previous week would start with the one “big idea” concept that the students would require for the evening’s lecture. In this case, nearly 100% of students knew that there is a difference between “information” and “data”, namely that “information is the useful interpretation of facts & figures.” If the “big idea” concept didn’t have adequate traction, it would be presented again in a different format to reinforce it. After celebrating this success...
2. The class would be introduced the Worst Done Question. This slide was accompanied with a short sound clip of *Toccata Carpimus Noctum* to grab their attention.

3. In the lecture, the students would be asked *the same question* (the worst done question) from the quiz this time using Tophat Monocle’s “MonocleCAT”—the in-class classroom response system. The quizzes in CourseLink were set-up using a test bank of questions; every student would get questions at random from that bank so not every student would have seen the worst done question.

4. MonocleCAT will display a histogram of results after the students log their response to the question on slide (3). At slide (4), the in-class results were compared with the quiz results. In most cases the in-class results were better. The relevant portions of the content from the textbook are highlighted and some discussion would take place as to why students taking the quiz chose the answer they did and why students had different responses in the lecture. With the “a-ha moment” of understanding the worst-done question complete, the lecture would move on.

Note: This sequence of “main idea” and “worst done question” is an example of JiTT; it is not the entire extent. It was the most overt presentation of the material—comparing the quiz to the day’s topic—but other concepts would also be included, prefaced with commentary like “students seemed fuzzy on this concept” as it was reintroduced.
Why Just-in-Time Teaching Works

As Novak observes, “Timely Web assignments prepare students and instructors for subsequent in-class interaction, give students some control over their learning, and enrich in-class meetings.”12 In MGMT*1000 the same effects were observed—rather than using valuable lecture time to introduce/review ‘the basics’, students can pick those up on their own and the instructor can use the lecture to integrate and apply these concepts into the larger course objectives.

It should be noted that the administrative overhead required to prepare a large test bank of quiz questions for each weekly quiz prevented the JiTT approach from being applied beyond the Concept / Integration interface of Figure 3. There is nothing inherent in this method that would preclude it from being part of the Integration / Application interface of Figure 3. A second quiz or assessment exercise testing student knowledge from the lecture could have been administered and the results interpreted by the Undergraduate Teaching Assistants in order for them to tweak their seminars, but with 11 UTAs, 20 seminars, and two Ivey / Harvard cases per seminar, there was sufficient administrative burden without the additional complexity of a second JiTT process.

Finally, as Simkins and Maier conclude: “The benefits of the JiTT approach can be summarized as follows:

a. Students are more likely to be prepared for class,

b. The use of student responses in class creates a positive feedback loop that promotes further learning,

c. JiTT exercises make instructors more aware of student thinking processes, and

d. JiTT pedagogy increases students’ cognitive learning.”¹³

Anecdotal Support

There is a well used cliché that “anecdotes aren’t data” and in this analysis of MGMT*1000 there was no set up of a comprehensive study to research the effects of JiTT in the course setting. That said, it is worth sharing some anonymous student comments from the online course evaluations regarding this approach. First, a negative comment about JiTT:

But it isn’t really helpful with my every week’s quizzes. For the quiz, i still have to go back to books on my own. Lecture just gives me an overview, but for details I’ve to go over myself.

It may be the case that this comment stems from the difference between the student’s perceptions of what a lecture should be and what the JiTT lecture actually was. Perhaps the explanation in the course outline should be more clear about the expectations and outcomes of the JiTT process. However, on the positive side:

- The weekly quizzes made sure I had to keep up with the work in order to not fall behind.
- Doing the online quizzes is where I actually learned the most content; by going through the textbook to find the answers.
- The consistency, how each week we followed the same pattern of reading, quizzes, lectures, etc.

¹³ Simkins and Maier, “Using Just-In-Time,” 444.
- I found the weekly quizzes really helped re-enforce my learning. By having them it forced me to keep up with the readings and review my notes.

The first and last comments are consistent with Simkins and Maier’s observation that students are more likely to be prepared for class. The second comment speaks of the positive feedback loop promoting further learning. The third comment is useful from a course design perspective in that students like the consistency, predictability, and pattern of the JiTT cycle.

Conclusion

The Wikipedia entry\(^\text{14}\) for just-in-time teaching lists four goals for this approach: to increase learning during classroom time, to enhance student motivation, to encourage students to prepare for class, and to allow the instructor to fine tune the classroom activities to best meet students’ needs. The experience from MGMT*1000 and the experience of others like Davis, Maier, Novak, and Simkins reflect the fact that the JiTT approach to the classroom meets all four of these goals. With a limited amount of lecture time, shifting (or “flipping”) the base content to before the lecture meeting time frees up that time for deeper learning activities. Students are motivated by the quiz marks to some degree, but (hopefully) are motivated to come to class to find out more about a concept they struggled with earlier. Students are more prepared, as evidenced in the literature and anecdotally from the students themselves. Finally, the instructor is empowered through the information gained from the assessment activities to tailor the lecture and the learning activities to address real learning gaps.

Bibliography


