Work in Progress: Student Behaviors Using Feedback in a Blended Physics Undergraduate Classroom

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Abstract

Two major benefits of Massive Open Online Course platforms are their collection of fine grain data on student interactions with the course website and their capacity to give students immediate feedback on their work.

We study the patterns

of students' usage of immediate feedback in an undergraduate physics course that uses blended learning, and we present informative aggregate descriptives from this 474-student class. We find that overall student study strategies mirror those in

"traditional" courses, that students strategically use the auto-checking feature of the platform, and that they extensively use the other content resources available to them on the platform. Several of these findings support educational research that has not had the benefit of the data MOOC platforms give us access to. Better understanding of how students engage with blended learning will aid residential instructors in tailoring in-class time and providing their students with recommendations for approaches to studying.

Author Keywords

MOOC platforms; blended learning; immediate feedback

ACM Classification Keywords

K.3.1 Computer Uses in Education: CAI

Introduction

Researchers in digital learning and analytics are just beginning to be able to guide instructors in how to maximize blended learning. Studies in blended learning [1], [2] have yielded mixed results so that best practices have yet to be identified with confidence.

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Variable	Ave	Med	Min/ Max
Total # of hours in problem-solving sessions	27	26	6 / 59
# of problems not attempted	1.16	0	0 / 17
Average time (hrs) between 1st check and due time for each attempted problem	69	64	5 / 216
Average time (hrs) between last check and due time for each attempted problem	58	53	3 / 192
Average time (hrs) between first and last check for each attempted problem with >1 check	13	11	0.07 / 61
# problem - solving sessions	20.98	20	5/ 49
Average interval (days) between problem-solving sessions	4	4	2/ 13

Table 1. Informative descriptives highlighted in this WiP paper. All variables are averaged across students (noted where averaging across problems/sessions).

Background and Conceptual Framework

We use data gathered from an introductory physics course, “Classical Mechanics,” offered at MIT in fall 2014. This class, which is the first in a two-course physics sequence required of all undergraduates, has been taught in a blended learning format since 2003 [3]. Known as Technology Enabled Active Learning (TEAL), the course combines short lectures with desktop experiments and in-class problem solving [3]. Although students had access to extensive materials on the course website, in 2014, online assessments, powered by the edX learning platform (www.edx.org), were added. One of the most popular capabilities of the online assessment is the “checkable answer feature” (CAF), which immediately indicates to the students whether their answer is correct or incorrect [4]. The course instructors and researchers believed this capability would particularly benefit student learning given research into feedback [5], [6] and time on task [7], [8]. Data collected for this study has helped to confirm this hypothesis as well as to support those earlier studies.

Data

In this work-in-progress, we focus on the usage behaviors of students whom we observe via the MITx platform. Student behaviors are recorded by logging every time a student “clicks” on a link on the course website, which could include navigation to a content resource or submission of an answer to the CAF. We have time-stamped logs from September 1st to December 31st, 2014, during which time students’ interactions with the course website resulted in more than 30 million interactive events, constituting more than 8 GB of raw log data.

Students were assigned weekly problem sets as homework; 2 problems were submitted completely online and 4 to 6 were handed in. For the 22 online problems, as soon as students received a “correct” check via the CAF for that problem, they were awarded the points. For the 63 written homework problems that were distributed online, students could check interim steps via the CAF, but they were required to write out all of their work and submit it on paper. In this study, we focus on interactions with the 22 purely online problems. Our logs include the sequence of incorrect and correct answers students submitted for every one of the problems the students attempted.

Methods

We provide basic descriptive statistics in this paper as the first step in our analyses. Our goal is to better understand the aggregate picture of student behaviors using the CAF. We therefore illustrate both measures of central tendency and spread, noting that some of the distributions of student online behaviors are somewhat skewed. This reflects the extreme levels of skew observed in solely online MOOCs [9]. Because we have log data, we provide aggregate estimates for all 474 students enrolled in the fall 2014 course. We measure student behaviors on 30 different metrics, such as number of total checks, the average time interval between CAF checks for a given problem, and the total time spent watching videos during a problem solving session.

Findings

We found that emergent results could be grouped into three main areas of insight: findings related to the “big picture” of students’ macro strategic behaviors working on the online problems, findings related to students’

Variable	Ave	Med	Min/ Max
Average # incorrect checks for each problem	4.69	4.00	0.23/ 36.73
Fraction of attempted problems where first try correct *	0.19	0.16	0.00/ 0.69
Fraction of attempted problems where last try correct	0.83	0.88	0.00/ 0.90
Average # correct checks for each problem	0.92	0.95	0.05/ 1.77
Average time (hrs) between 1st & 2nd check for each attempted problem	3	1	0.01/ 20
# weeks with overlap between problems	5.78	6	0/ 9
Average length (min) of sessions	77	76	2/ 107
Proportion of incorrect checks with other activities after	0.03	0.02	0.00/ 0.18

Table 2. Informative descriptives highlighted in this WiP paper. All variables are averaged across students (noted where averaging across problems/sessions).

*weighted by problem difficulty

“micro scale” problem solving and checking behaviors, and findings related to the resources that students used to a greater or lesser extent while solving online problems.

“Big picture” student behaviors

On average, students spent about 27 hours engaged in problem solving sessions working on the online homework problems (Table 1). Given the 22 online problems over the course of the semester, this is a rough average of about 74 minutes on each problem. This meets traditional homework expectations for the course (MIT Bulletin; 8.01 listed as 3-2-7; see <http://student.mit.edu/catalog/m8a.html>).

On average, students started the online problems three days before they were due ($\mu = 69$ hours), and, on average, they made the last check on the online problems about 2 ½ days before they were due ($\mu = 58$ hours). On average, students had nearly 21 problem solving sessions over the 15 weeks of the class, with an average of four days between problem solving sessions. Overall, we found that students approached the online component of their problem sets in a manner similar to traditional homework assignments.

Student micro scale checking behaviors

The detailed individual clickstream data allow us to see the ways in which students engaged in answer checking via the immediate feedback feature. Across all of the online homework problems, students had an average of nearly 5 incorrect answers per problem ($\mu = 4.69$). After weighting the problems by difficulty, we see that, across problems, about 20% of the attempted problems were checked as correct on the first try ($\mu = 19\%$), and

about 92% of the checks for any attempted problems were correct ($\mu = 92\%$).

On average, students took about 3 hours between the first and second check for a given problem, if they checked a second time. However, if we average across all of the problem checks instead of just the first two, it appears as though the first and second check are necessarily farther apart—the average time interval between checks for the same problem is approximately 4 minutes. Although some students take much less time between checks (e.g., they might have quickly changed a response to reflect a possible algebraic mistake) and some take much more (e.g., they might have talked to other students), most do take enough time to use the feedback and reflect before resubmitting.

Since the average overlap time is 12 hours from the first check of the second problem to the last check of the first, it seems as if students were working back and forth between problems strategically. If we look across students, there was an average of 6 weeks (about half the semester) when there was overlapping time back and forth between the online problems ($\mu = 5.78$ weeks).

The average problem-solving session was 1.25 hrs. ($\mu = 77$ min.); those sessions happened, on average, every 4 days. This is much less than what deliberate practice research gives for experts’ level of work (~4 hrs./day) [10].

Resource usage

Most students did use the variety of online content resources they were provided, although, on average,

Variable	Ave	Med	Min/ Max
Average time (min) viewing videos in each session	18	0	0/ 180
Average time (min) viewing e-text in each session	49	29	0/ 360
Average time (min) viewing class PDF notes in each session	18	6	0/ 240
Average time (min) viewing problem-solving session notes	7	0	0/ 120

Table 3. Informative descriptives highlighted in this WiP paper. All variables are averaged across students (noted where averaging across problems/sessions).

they used them at low levels. Interestingly, students looked at other resources after getting an incorrect check only 3% of the time. During any given problem solving session, students spent an average of 49 minutes browsing the e-textbook, 18 minutes watching videos, 8 minutes looking at PDF notes of in-class problems, and 7 minutes looking at problem-solving session notes.

Discussion

From this study, we see that students in a blended college/university physics course behave in ways that mirror our sense of how they work in traditional courses. For example, we see variation in when students start their homework, that they don't finish it in one sitting, and that they work back and forth between problems. However, in the fall 2014 version of the course, we see students making frequent use of the instant feedback from the "checkable answer feature." We know that in traditional courses, students use other resources to do their homework, but we can now see what they are using and for how long.

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