Improving Introductory Computer Science Courses Through Learning Analytics

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Introduction

As jobs that require programming experience continue to rise, the demand for students in these fields rise as well. How can we improve our introductory computer science courses to ensure students get a positive experience with computer science? Improving the educational experience in first year computer science is the first step.

Computer science is a challenging course, often with high fail rates. Understanding what topics students struggle with, actions that successful students take in the course, and reporting this data back to instructors and students may help decrease the fail rate.

The end-goal of this research project is to develop a system that collects data based on use of the system, perform data analysis to predict trends, and displays findings that is of use back to both students and instructors on a dashboard.

Related Work

Similar research has been found on the topic of learning analytics collected from Learning Management Systems. Dietz-Uhler and Hurn describe how “learning analytics can be used to help students succeed and to improve retention.” and where “learning analytics can provide insights into what is happening with the learner in nearly real-time” **.** Macfadyen and Dawson have found the most significant predictive variable a biology course was "measuring total student contribution of messages to course discussion forums” and provide research that can “confirm that the degree of student engagement with peers is an important indicator of success in a course.”

References

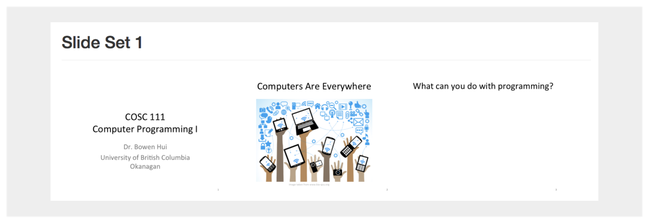
Dietz-Uhler, Beth, and Jane E. Hurn. "Using Learning Analytics to Predict (and Improve) Student Success: A Faculty Perspective." *Journal of Interactive Online Learning* 12.1 (2013): 17-26. Web.

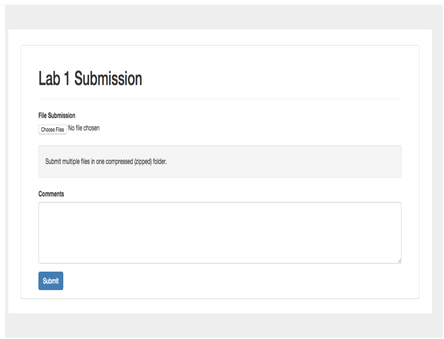
Macfadyen, Leah P., and Shane Dawson. "Mining LMS Data to Develop an ‘‘early Warning System” for Educators: A Proof of Concept." *Computers & Education* 54 (2010): 588-99. Web.

Implementation

Discussion Forum – number of questions posted, replies posted, category of post, and total amount of time spent on the forum is tracked for each user.

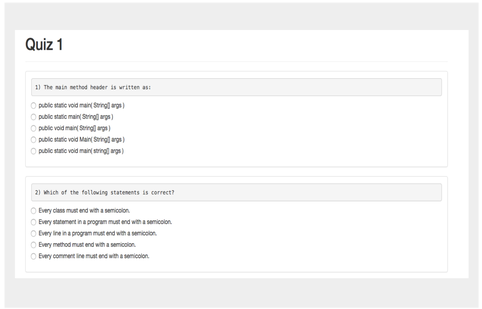
Slides – organized by topics, amount of time spent on each topic is track for each user.





Lab and Assignment Submissions – time spent on viewing pages, date of submission, number of attempts are tracked per user.

Quizzes – number of attempts, grade for each attempt, time of attempt, and time spent on quizzes are tracked per user.



Evaluation Plan

Evaluate common actions that successful students take in the course:

- Find students that have done well in the class and look for trends in time spent on slides, labs, checking grades, questions posted in forum, replies in forums etc.

Understanding topics students struggle with:

- Report topics that students spend the most time on in slides.
- Record how well they do in those topics in exams, how does this compare to time being spent in slides.

Report trends back to instructors and students:

- Instructor Dashboard
  - ➢ Report to instructor topics that students are spending the most time on.
  - ➢ Predict students that are at risk of failing.
- Student Dashboard
  - ➢ Show students how their tracked data compare to the average student.
  - ➢ Display suggestions for ways they can improve their grade based on actions successful students have taken in previous years.

Course Analytics (Over 2 Week Period)

Pageviews over time

	Page Title	Pageviews	% Pageviews
1.	Home	1,449	14.86%
2.	Slides	1,433	14.69%
3.	Submission	1,202	12.32%
4.	Labs	1,199	12.29%
5.	Quiz	944	9.68%
6.	Thread	643	6.59%
7.	Login	595	6.10%
8.	Assignments	281	2.88%

Order of pages most viewed

	Page Title	Page Count	Unique Pageviews	Avg. Time Spent on Page
2.	Slide Casting, Naming Convention, Constants, I/O	141 (1.45%)	104 (2.06%)	00:06:41
3.	Slide Variables	172 (1.76%)	111 (2.19%)	00:05:44
4.	Slide Data Types and Expressions	177 (1.81%)	109 (2.15%)	00:05:02
5.	Slide Introduction to Java	178 (1.82%)	118 (2.33%)	00:04:11

Order of slides viewed most based on avg. time spent on page

	Page	userId	Pageviews	Unique Pageviews	Avg. Time on Page
			172 % of Total: 1.76% (9,754)	107 % of Total: 2.12% (5,059)	00:05:12 Avg for View: 00:01:31 (243.53%)
1.	/slide/9	65	1 (0.58%)	1 (0.93%)	00:26:25
2.	/slide/9	82	1 (0.58%)	1 (0.93%)	00:24:52
3.	/slide/9	10	2 (1.16%)	2 (1.87%)	00:23:11
4.	/slide/9	78	2 (1.16%)	2 (1.87%)	00:18:43

Students who view slide 9 (Data types and Expressions) most

Time spent viewing slide 9 (Data types and Expressions) over time