# Using the CWSEI Approach to Updating Computer Science Systems Courses


## Donald Acton — acton@cs.ubc.ca

*Department of Computer Science, University of British Columbia*


## BACKGROUND

Over the last 2.5 years we have been applying the CWSEI approach to modifying the primary Computer Science systems courses. These courses are: CPSC 213 (*Introduction to Computer Systems*), CPSC 313 (*Computer Hardware and Operating Systems*), and CPSC 319 (Internet Computing).

All computer science majors are required to take CPSC 213 and except for a few combined majors all are required to take CPSC 313. CPSC 317 is an elective course in computer networking taken by well over half our students. Given our limited resources (1 person @ 20%) we focused on undertaking transformations and interventions that have worked well in other disciplines.

## 1 Learning Goals and Baseline Data

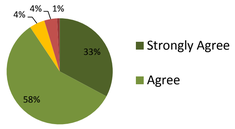
In all the courses we:

- Articulated the course level learning goals
- Articulated the finer grained learning goals
- Undertook pre- and post- course attitudinal and surveys and identified key exam questions to provide baseline data

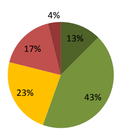
| Topic | ID | Learning Goals Students Can... |
|---|---|---|
| ALU/Registers/ Memory | A1 | Describe a basic computer with basic components (ALU, Registers, Memory) and explain how instructions execute and data flows. |
| Machine Level Instructions | B1 | Trace execution of a simple C program and translate to a set of machine level instructions to emulate that C program |
| | B2 | Identify and group Gold Assembly instructions based on their utility for programming(control flow of execution, access memory, arithmetic operations, etc.) |
| | B3 | Describe in what ways instructions and data are the same at the bit level |
| | B4 | Translate a Gold Assembly instruction into machine representation (in bits) |
| | B5 | Decipher according to Gold Assembly language rules the various parts of an instruction (opcode, operands, etc) from the bit |
| | B6 | Identify what information is available to an instruction statically and what must be calculated dynamically at run time. For example, instructions are created ahe and are static but that the data they access, including the memory addresses to be accessed may be only calculated or available at run time |
| | B7 | Recognize that subtracting a number from another involves taking the twos complement of the number and adding it. Be able to apply the principles of twos co implement sign extension.* |
| ISA Design | C1 | Describe the minimal set of addressing modes needed for an instruction set to be complete. |
| | C2 | Compare and contrast various addressing modes (e.g. the limitations of not supporting a particular mode in an instruction set, why dynamically generated addre |

## EXAMPLE SURVEY QUESTIONS

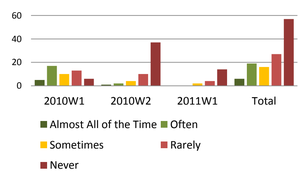
Course Material is Interesting




Lecture is Engaging

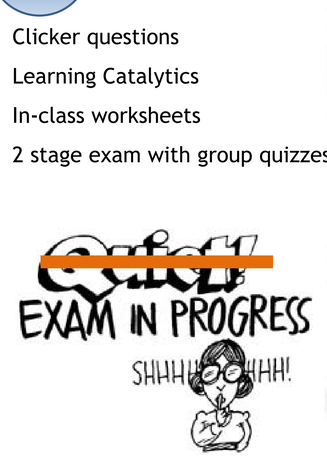


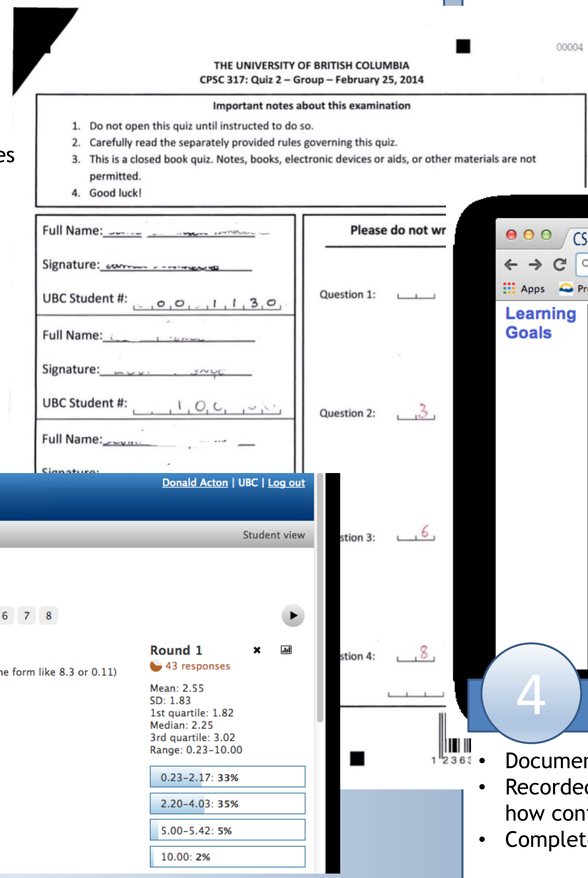

How often did you complete the practice problems?

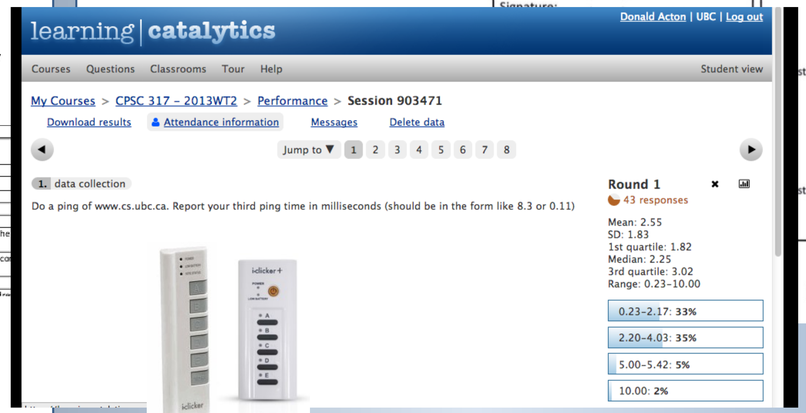



## 2 In Class Interventions

1. Clicker questions
2. Learning Catalytics
3. In-class worksheets
4. 2 stage exam with group quizzes

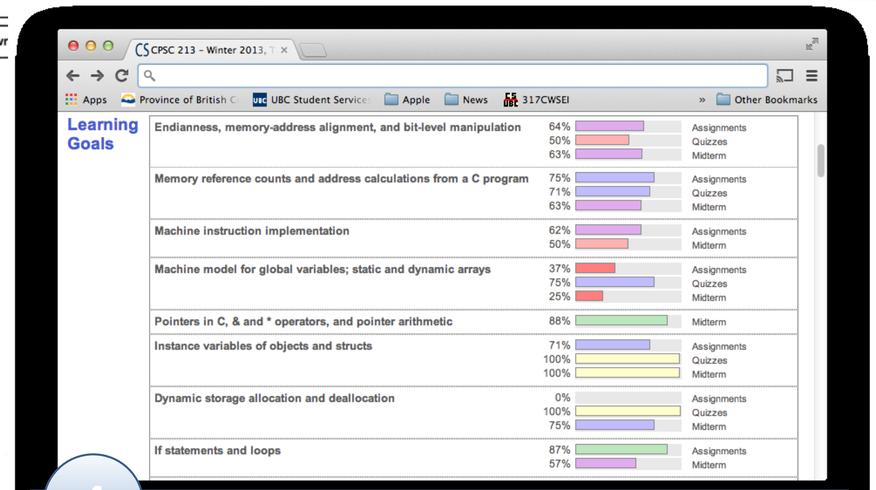



## 3 Improving Student Feedback

- Visually feedback assessment activities vs learning goals
- Learning catalytics – promotes self reflection in real time
- GIT – Source code control – allows closer monitoring of student progress and ability to provide more timely feedback
- Scanned Exams & Assignment results in more timely & organized feedback




## 4 Instructor Resources

- Documented course timelines:
- Recorded lecturers to provide future instructors an opportunity to observe how content is presented and the amount of time used
- Complete set of lectures time materials and assignments

## 5 Feeding Back

- Post survey questions used to identify course presentation and organization needing improvement
- Exam questions results correlated to interventions to identify what works and what doesn't

These measurements are being used to iterate over our course changes


The work in these courses has been in part undertaken by: Mike Feeley (213/313), and George George Tsiknis (213/313) , Bill Aiello (317), Donald Acton (313/317). Norm Hutchinson has also provided valuable comments and suggestions


| February 16 | |
|---|---|
| 9:38 – 10:16 | I was concerned that I wasn't going to have enough material for this lecture. But, this exercise took way longer than expected, but in a good way. All the students really worked on the problem. There was good interaction between students and lots of debate … Although it went way longer than I expected, I think it was a really good activity. There was quite a bit of confusion about how GBN and SR really worked and I think this activity really allowed them to explore that. |
| 10:26 – 10:46 | The great thing about this activity was that when it was finished students seemed really interested in how to go about solving the problem. I think this might have been because they had to struggle with how to think about and organize things so they were ready to "receive" … the answer. … |


This work is supported in part by: CWSEI Carl Wieman Science Education Initiative at the University of British Columbia