AT HOME WITH ENGINEERING EDUCATION

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#ASEEVC
Experiences in Developing a Robust Popular Online CS1 Course for the Past 7 Years

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Our journey (2012 – today)

- 2012: CS1 online first offered
- 2013: Use online interactive content (Joomla)
- 2014: Piazza Discussion forum
- 2016: Fully synchronous CS1 online
- 2017: Switched to zyBooks’ autograder
- 2019: All CS1s use MSPs
- Survey students regularly

- Offer additional online help
- Integrated discussion forum
- Auto-graded exams
CSI course details

Public research university
- Ranks among top 20 public universities
- Serves a majority of students from minority groups & first-generation college students

Operate on a quarter system
- 300-500 students /quarter
- 80-100 online students /quarter

Course
- CS majors and Non-majors
- C++: input/output statements, assignments, branches, loops, functions, and vectors
- 3 hour lecture, 3 hour lab, midterm & final
2012

- First time teaching one online CS1 section
- Desire: better serve our students
- Thought: flexibility, cross-campus enrollment, scaling, additional revenue
- Learning outcomes OK, evaluations were acceptable, instructors were satisfied
- Lots of room for improvement
2013 - 2014

- Online interactive content (homegrown)
- Automated program grading
- Asynchronous class structure
- Discussion forum (Piazza)
- No recorded video (almost)
- Exams
We learned

• Students loved the interactive learning content
• Appreciated the automated grading of homework, but we had system issues.
• Good use of Piazza

Biggest lesson: students did not do well without meetings

• Trouble getting motivated
• Most did not watch the videos content
2014 - 2016

From asynchronous to synchronous

• More online meetings; eventually scheduled online meeting times
• Read before class; more examples during ‘lecture’
• Active ‘lecture’
  • Live coding
  • TA involvement
  • Chat
• Labs
• Course content - zyBooks
Active ‘lecture’ – Live coding & TA involvement

Screenshot of our CS1 online synchronous ‘lecture’
Active ‘lecture’ – Chat

Screenshots of the chat box from lecture

“I found the chat box very helpful during lecture”
Course content - zyBooks

(right) Sample TOC showing content covered each week

- 1. Wk1: Introduction
- 2. Wk2: Variables/Assignments
- 3. Wk3: Branches

(left) Programming assignment given to students via the program auto-grader

2.22 LAB: Divide by x

Write a program using integers `userNum` and `x` as input, and output `userNum` divided by `x` four times.

Ex: If the input is 2000 2, the output is:

1000 500 250 125

Note: In C++, integer division discards fractions. Ex: 6 / 4 is 1 (the 0.5 is discarded).
2017 - today

Experiment with new features

- Many small programs (MSPs)
- Survey methodology
- New chat forums (Discord)
- Auto-generated auto-graded exams
- Coral language
Many small programs (MSPs)

MSPs: Smaller programming assignments each week

- Exam scores improved
- Students less stressed
- Multitude of other benefits
Summary: then vs. now

Grades
• 2016: in-person (87%) vs. online (77%)
• 2019: in-person (86%) vs. online (83%)

Student evaluations
• 2013: in-person (4.3) vs. online (3.7)
• 2019: in-person (4.5) vs. online (4.5)
Student comments

• “I thought I wouldn't like the online class but I really enjoyed the class and learned a lot from the first day.”

• “I strongly would recommend anyone to take this course online rather than in person! Believe it or not, this was actually my most interactive class even though it was online!”

• “At first I was completely unaware that this was an online class, and after that I was pretty wary. However, after taking the class, I realized that the online format works really well and is as good as or even better than taking an in-person class. I absolutely loved this class.”
Conclusion

OK course in 2013 is now one of the most popular and highest rated courses

- Offer at least one CS1 online course every quarter since 2013
- Grades and evaluations between in-person and online are almost identical

Key lessons

- Synchronous online meetings
- Online chat forum (especially with a TA present)
- Quality online interactive content (no videos)