CS6460 Final Project

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1 Introduction

While massively open online courses (MOOCs) have successfully opened online learning to a large group of people who would otherwise not have access to higher education, MOOCs still are plagued by issues of student retention and engagement. Some MOOCs -- free ones in particular -- see recidivism rates as high as 86% over the course of the term (Gomez-Zermeno & de la Garza, 2016). This is considered one of the major weak points of online learning.

This paper analyzes research on the effects of learning in an online course with a non-linear structure, as opposed to the traditional one-video-after-another format, with respect to student retention. This was done by performing A/B testing on a custom-made online course which was playfully dubbed a "micro-MOOC" on account of its 15-minute length.

The hypothesis for this experiment was that experiment group users would be more engaged with the course content and would have better information retention. The former would be measured by student recidivism across the lessons, while the latter would be marked by higher scores on the final quiz.

2 Prior Research

The basis for this hypothesis comes from a variety of past research done on courses with non-linear structures.

One of the first experiments that examined the effect of non-linear educational material used a freely explorable sandbox in a college-level geology course (Chen, 2002). In this paper, the author found that not all students performed well with the non-linear material. In particular, students who were not skilled in doing their own research and constructing their own learning paths were less happy with the course and performed more poorly than those who were more comfortable with self-led learning. The author also recommended an adaptive course that would match the learning preference of the student.

The next major study came from a midwestern US university, where a foreign language course had two separate websites for students to use -- one that had all the lessons in a strict linear progression and one that listed all of them immediately (Cagiltay et al., 2006). The students were allowed to use either website they wanted. Like the study already mentioned, this found that independent, self-led learners tended to prefer the more open method of learning. Additionally, it found that students with more experience using computers generally performed better with the non-linear course.

Later on, Grünewald et al. (2013) tried to design a course that would combine he best aspects of cMOOC and xMOOC style courses. The researchers found that the most promising techniques included "concept maps and hypertextual links that allow diverging, learner-defined paths" and "group discussions that… allow learners to feel responsible and collaboratively strengthen the learning process". This matches the results of another study in which 76 students were surveyed about learning in a connectivist environment. This study showed that students in these connectivist courses were motivated and engaged, and collaboration was actively supported (Conradie, 2014). Both of these studies show that courses including aspects of connectivist pedagogy, an inherently non-linear ideology, encouraged engagement, responsibility, and collaboration.

3 Course Details

The course website is a collection of static web pages generated using Jekyll, a program that creates HTML pages from templates, and some custom JavaScript. The lessons consist of pages with a header, an embedded YouTube video, and either a link to the next video or a link to the homepage depending on whether the user was in the control or experimental group.

Users were randomly divided into control and experimental groups upon visiting the site for the first time. This was done by assigning each user a hexadecimal UUID and checking the parity of the final digit. For the control group, the home page showed only one button, which was linked to the next lesson for that users. Meanwhile, experiment group users were shown all lessons on the home page without any restrictions on what lessons they could view in what order.

After all lessons was a 9 question quiz written in JavaScript. Like the lessons, experiment group users were free to take the quiz at any time, even without

having watched any lessons. Members of the control group had to go through all of the lessons before having access to the quiz. Each user's response to each question was recorded to be analyzed later.

In the background, the site recorded the Unix time when each visitor first visited each lesson page. With this information, we can determine how long each user spent on the site and how many of the lessons they watched. Both the quiz results and the lesson start times were recorded using Google's Firebase platform, which allowed easy saving of data in a simple JSON format.

After the course itself was an optional survey meant to gather some qualitative data about the course in addition to the quantitative data gathered automatically.

4 Experimental Data

The following data was downloaded the morning of Saturday, July 20. This is a summary of the user data collected by the site. The full JSON data can be found in the GitHub repository for the website, inside the "_analysis" directory (see the Links section below).

Number of testers: 162

Control group size: 89

Experiment group size: 73

	Lesson Views		
	Total	Control	Experiment
Introduction	128	86	42
Why Cast Iron	91	60	31
Cooking	76	50	26
Baking	60	43	17
Cleaning	58	43	15
Chemistry of Soap	53	38	15
Seasoning	62	40	22
Removing Rust	53	38	15
Common Mistakes	49	36	13
Conclusion	47	32	15
Final Quiz	59	30	29

Figure 1. Lesson views, total and divided by group.

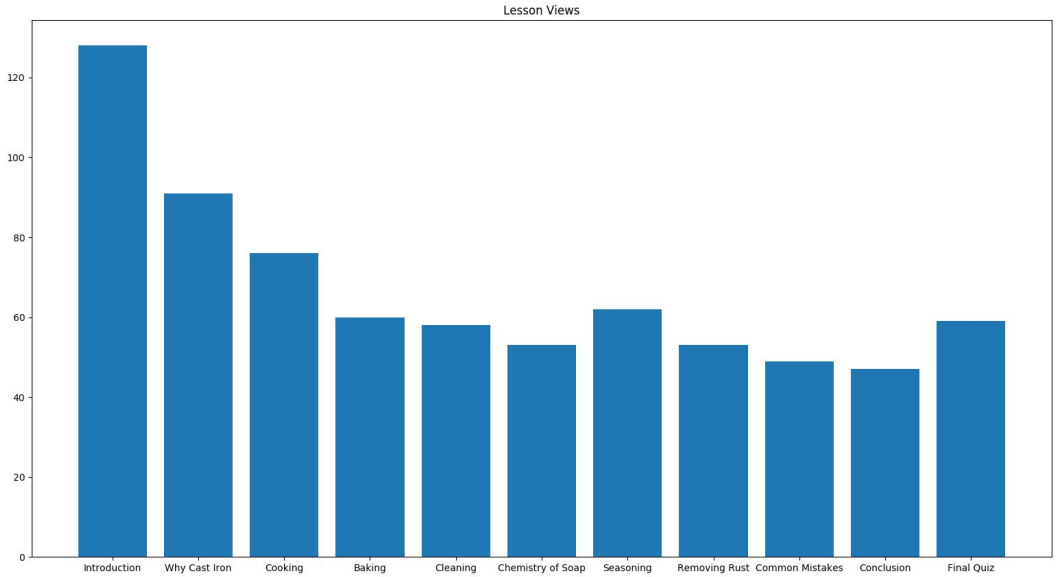

Figure 2. Total lesson views, visualized as a bar graph.

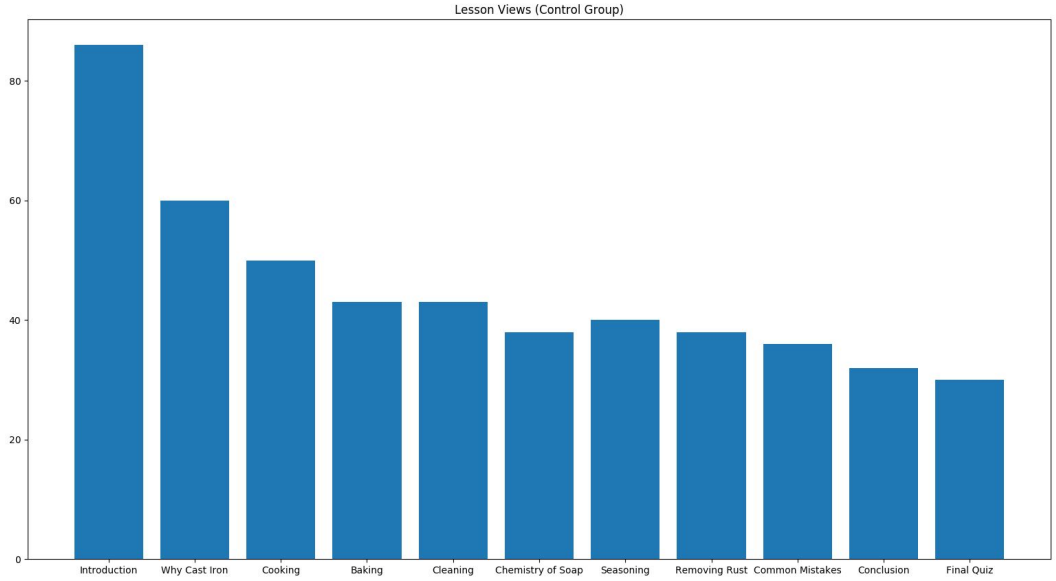

Figure 3. Control group lesson views, visualized as a bar graph.

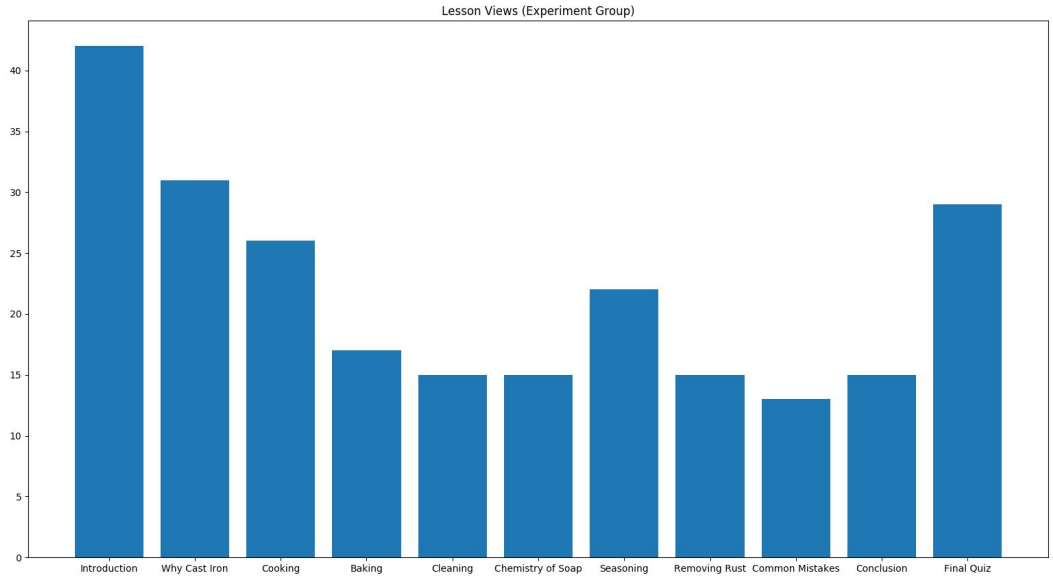

Figure 4. Experiment group lesson views, visualized as a bar graph.

5 Quantitative Data Analysis

First is some basic statistical analysis of the quantitative data gathered during the course:

	Control	Experiment	Total
Completions	27	24	51
Average Score	6.93	6.67	6.81
Conf. Interval (95%)	±0.74	±0.82	---
Standard Dev.	1.88	1.99	1.92

Figure 5. Summary of quantitative data.

With these figures and the data listed above, a few conclusions can be drawn. First, and most striking, is the fact that a significant number of the experimental group users did not watch any of the lessons. Of the experimental group, only 42 out of 73 students (57.5%) viewed the introduction video, compared to 86 of 89 control group students (96.6%). On the other hand, a larger percentage of experimental group users completed the final quiz (30 of 89 or 33.7% control group versus 29 of 73 or 39.7% experiment group). These two facts together lead me to believe that many of the experiment group users skipped directly to the

final quiz to test their own existing knowledge rather than experiencing the course itself.

Unfortunately, the final quiz scores are too close together to reveal anything of significance. Assuming a confidence level of 95%, the intervals for the mean for each group overlap by a large margin.

6 Qualitative Data Analysis

In addition to the data gathered automatically, testers were invited to complete a more in-depth survey that considered the tester's perception of the course in addition to their quiz scores. Below is a short breakdown of their responses:

	Experiment average	Control average
Time taken	16.00 minutes	14.08 minutes
Level of boredom (1 to 5)	2.54	2.29
Amount learned (1 to 5)	3.85	3.50

Figure 6. Summary of qualitative data.

These results show that the experimental group thought they spent more time on the course on average and thought they learned more, but they also reported a higher level of boredom overall.

In addition to these numeric responses, the survey allowed open-ended responses to the following questions:

1. Would you recommend this course to others interested in cooking? Why or why not?
2. What, if anything, would you change about this course?

Going through the responses, there were some common threads in both the control and experimental groups. First, the two most common structural complaints among control group users were that the course should not have been divided into so many short videos and the course would have benefitted from a table of contents or another means of outlining the course material beforehand. On the other hand, experiment group users seemed to wish the course was more streamlined, with the "Continue" button leading to the next video rather than going back to the home page.

7 Mistakes and Changes

Given the above analysis, there are a few things that should be changed if this experiment were to be done again.

The first and greatest mistake was in how the course was advertised. The link was spread online, including the course Piazza page and several subreddits related to cooking. Because of this, many testers already had knowledge of cast iron cooking, and users with this foreknowledge may have skewed the scores of the final quiz.

Additionally, the non-linear course site should be modified so that the final quiz can only be taken after a set number of lessons have been viewed. This would prevent testers in the experiment group to skip immediately to the end as so many did in this trial.

8 Links

First is the link to the course I developed for this experiment: https://cooking-mooc.firebaseapp.com/

This link to the source code for the site and the Python script I used to analyze the quantitative data gathered automatically during testing. Data gathered and survey results can be found in the "_analysis" folder: https://github.gatech.edu/bhaines3/cs6460-mooc-theme

9 Bibliography

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