

## **Reducing Cognitive Load through Reminders**

For my master's project, I decided to continue the research and experiments begun in Educational Technology and independent study. The original project objective in Ed Tech was to reduce student attrition by helping non-traditional students in online-only courses access their classwork on the go and keep track of their assignments. The original project was for a class I taught online for a private college. The sample size was small, consisting of only twenty students, and it was content-dependent. I ran the experiment using a mobile app and mobile-friendly website for coursework delivery, followed up with a survey for feedback. Over the progression of the second run of the experiment, I concluded that I needed to focus on one common issue that affected student attrition, cognitive load, instead of trying to address several factors.<sup>1</sup> By reducing a student's overall cognitive load, I hypothesized that I could improve course completion rates and boost performance, thereby reducing attrition.

### **What is Cognitive Load?**

Cognitive Load Theory (CLT), as developed by Paul Kirschner, theorizes that people have a limited amount of working memory used for the processing of new information. The new information, such as instruction of new content or skill, is later transferred to long term memory. This working memory is limited to about seven elements of information at any given time, (Kirschner P. A., 2012). The application of CLT to instruction is not just limited to promoting learning while staying within the limits of students' working memory. Students also must plan and organize to keep up with their assignments and readings as well. If a student's working memory is already close to full with concerns about work,

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<sup>1</sup> See Carolyn Hart's review of factors of student attrition for a more detailed overview, (Hart, 2012).

family, and money, thoughts about getting homework done may get pushed out that list of seven elements. Therefore, one possible way to improve student course completion and improve performance is by helping them keep up with coursework, so they do not have to always rely on working memory to track what they need to work on, which was the focus of this study.

## **Approach**

The original idea for this experiment was to build on previous work, but to also capture a larger sample size that could be statistically significant. Since prior experiments were tied to one section of one course, it could not be scaled to work for different courses and multiple instructors. Whereas prior research had focused on resolving several possible factors involved in student attrition, such as content availability and assignment tracking, this work would only focus on tracking student assignments so it would be directly tied to one factor, reducing student cognitive load.

To attain a larger sample size, I chose to work with the Coursera MOOC<sup>2</sup> platform, since they usually have many enrollments, assuming there would be a large pool of potential subjects. Originally, I planned on tracking students on attendance, participation in discussions, homework completion/grades, test completion/grades, final grades, and whether they completed the course or dropped prior to completion. Since the Coursera semesters are short, the plan was to run the experiment twice. First, to use positive messaging in the reminders, such as, “keep up the good work!”, and then in the second run, do more varied messaging between positive, neutral, and negative messaging. During the first run of the experiment I also began designing and prototyping a web based platform using Coursera’s API<sup>3</sup>:

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<sup>2</sup> Massive Open Online Course.

<sup>3</sup> Application Programming Interface.

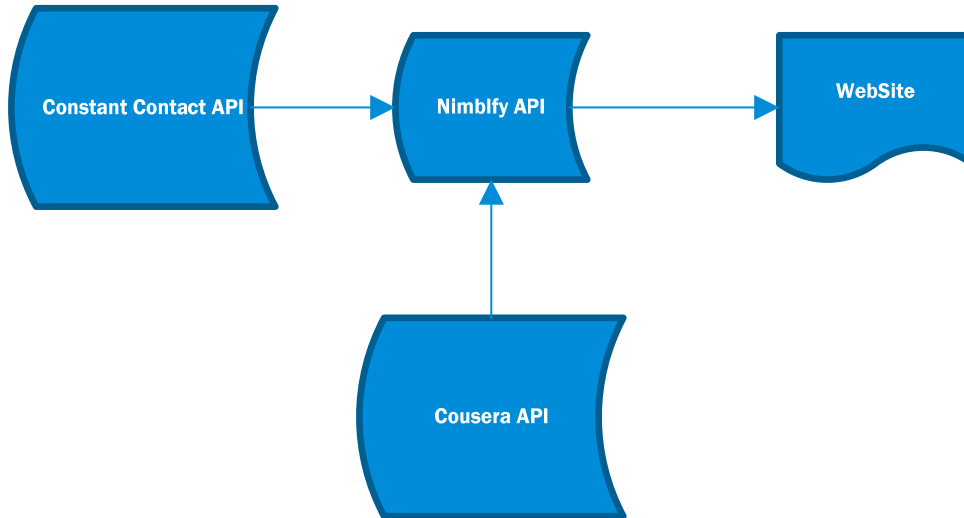


Figure 1, Original web application architecture

It would allow students to opt-in to the study, select the courses they were taking. Then the custom platform would use Coursera’s API to pull in coursework data for a class and send students reminders via email at varying frequencies using Constant Contact’s API to manage email. However, due to unforeseen complications, the study did not go as planned and the work on the platform was postponed until it could be redesigned.

**Recruitment and Experiment Process**

I asked professors at Georgia Tech who teach classes with the Coursera platform to participate in the study and requested that they help recruit their students for the experiment. For the first run, one instructor and fifteen of his students participated, out of the ninety-seven students enrolled in the course. Students opted in through an email opt-in form created on the Constant Contact website. The plan was to use their name and email address from the opt-in form and tie it back to a data export from Coursera once the course had ended so I could see if the reminders had an impact. The first class I worked with only required students to do weekly readings and quizzes; the expected level of complexity was not present. Instead of sending reminders per assignment, I opted to send email reminders twice a week, one five days before the quiz and readings were due, one email the day before they were due.

Coursera also sent out a weekly reminder, two days prior to the due date. The average open rate for the emails was 25%. At the end of the first run of the experiment, I sent out the survey, hosted on SurveyPlanet. Two students responded and their responses are included in the aggregate survey data discussed later in the paper.

For the second run of the experiment, another instructor offered to participate, and she taught three courses. Seventy-three students opted in. However, her courses were for students whose primary language was not English, which added another variable. Additionally, the information on who was taking what course and how many students were in these classes was not available. I attempted to contact students directly and find out what courses they were in, but only two responded. Despite the lack of metrics, I persisted and modified the experiment slightly, sending only one reminder a week to see if that would have an impact. Open rates on the email reminders averaged 21%. It was only after the second run was underway that I received the Coursera class data from the first run. After spending weeks sifting through the data, I realized that there was no way to tie the student names and email to the data export, so I could not tell if the reminders were having an impact. As of this writing, my contacts have Coursera have not responded with any updates to my request for this information. Consequently, the survey results offer only a window into the experiment's results, but not a complete overview.

## **Survey**

The survey was developed using Survey Planet's online platform. The survey consisted of 19 questions divided into three sections. The first section (three questions) asked respondents about their college experience, the second section (nine questions) were about issues that could provide some insight into a student's personal cognitive load. The last section were questions related to students' experience with the reminders from both my experiment and Coursera.

## Survey Results

While the survey sample is too small to be a scientific sample, it does provide some anecdotal insight as to what some students are dealing with in terms of cognitive load and its effect on their studies. The first two questions only tell us that most respondents have taken a class in-seat and most have completed at least one online course:

Q1	Have you taken any college courses in-seat (in a physical classroom)?	Yes	No
		13	2
Q2	Have you completed at least online class as part of a degree-seeking program?	Yes	No
		9	6

For question three, students were asked if they dropped an online course and if so, why. Respondents could select more than one option. 13 students indicated they had not finished an online course.

Q3	Have you ever started an online course but not finished it? If so, what factors have contributed to you dropping an online course?	
	Poor interaction with instructor	1
	Work obligations	6
	Family obligations	1
	Problems with course website	0
	Class was hard to follow	1
	Lack of communication with other students	1
	Too hard to keep track of assignments	1
	Not applicable	4
	Other (books not arriving on time)	3

Of the thirteen respondents who did not finish a class, the majority selected work obligations. This points more to a lack of time to study than a possible cognitive load issue, as only one respondent cited keeping track of assignments as a main factor. Continuing, students were then asked about work and their schedules:

Q4	Do you work full time?	Yes	No	
		8	7	
Q5	If you work a paid job, do you work at home or at a place of business?	Business	Home	
		13	2	
Q6	Is your work and life schedule Monday-Friday similar from week to week or does it differ greatly?			
Yes	Mostly	Somewhat	Rarely	Never
7	5	3	0	0

Interestingly, only a little over half of the students in this sample worked, and few had family obligations:

Q7	Do you have dependents who rely on you for daily care? (children, parents, etc.)	Yes	No
		4	11

The majority of respondents also spent less than five hours a week on course work.

Q8	On average, how many hours per week have you spent on course work, for all online classes you have taken?			
0-5 hours	5-10 hours	11-15 hours	16-20 hours	More than 20 hours
7	3	4	1	0

Q9	Where do you most of your course work?		
Home	Work	Library	Other
12	3	0	0

For question 9, “Where do you do most of your course work?”, the twelve out of fifteen work on it at home, with other three choosing work as their response. So, most students are only doing coursework at home, even though Coursera is mobile friendly.

Q10	When you work on course work, how far in advance do you complete it?		
Less than 24 hours before the due date	Less than 3 days but more than 24 hours before the due date	Less than 7 days but more than 3 days before the due date	More than 7 days before the due date
7	6	2	0

The responses to question 10 indicate that students are working on coursework week to week, but not an indicator that they are using the reminder emails to prompt them to complete their schoolwork. The last two questions in this section asked respondents about how they track assignments and if they have faced any challenges:

Q11	Have you encountered challenges in keeping track of assignments?	Yes	No
		10	5
Q12	How do you keep track of assignments?		
	Syllabus	Mobile Website	Other
	10	2	3

Most students responded that they have faced challenges keeping track of assignments, but also the majority only use the syllabus to keep up with coursework. The remaining seven questions deal with the students' interaction with the reminders:

Q13	Did you complete the assigned work for the week prior to getting the first reminder?	Yes	No	Didn't Receive It	N/A
		7	6	1	1
Q14	Did you complete the assigned work for the week prior to getting the second reminder?	Yes	No	Didn't Receive It	N/A
		8	5	0	2
Q15	Do you complete the work prior to getting the reminder from Coursera?	Yes	No	Didn't Receive It	N/A
		7	6	0	2
Q16	Did you complete the assigned work for the week after getting the first reminder?	Yes	No	Didn't Receive It	N/A
		7	6	0	2
Q17	Did you complete the assigned work for the week after getting the second reminder?	Yes	No	Didn't Receive It	N/A
		5	8	1	1
Q18	Did you complete the assigned work for the week after getting the reminder from Coursera?	Yes	No	Didn't Receive It	N/A
		7	8	0	0
Q19	Did you find the reminders useful? Why or why not?				
	Open-ended question, twelve positive responses.				

Student responses were inconsistent, unless they meant that in some weeks they completed the work before receiving reminders, and in other weeks they completed the work after receiving the reminders. For question 19, twelve students had positive responses, such as, "yes, the reminders are greatly useful to keep me on track" and "Yes, reminders are useful because we may fall behind the stuff we have to do." There was one negative comment, "No I have so much emails to by the time it arrives it get lost



within my emails”, which is a valid criticism, which is why the next run of the experiment will utilize push alerts instead of emails.

The survey and participation rates demonstrate some interest in using reminders to help reduce cognitive load, but without correlated evidence in terms of student course completion and academic performance, this information is anecdotal at best.

### Next Steps

The next project incarnation will attempt to scale the experiments up again, this time utilizing OMSCS<sup>4</sup> courses to recruit students. The technical component of the project will be the mobile app, under development, for both iOS and Android:

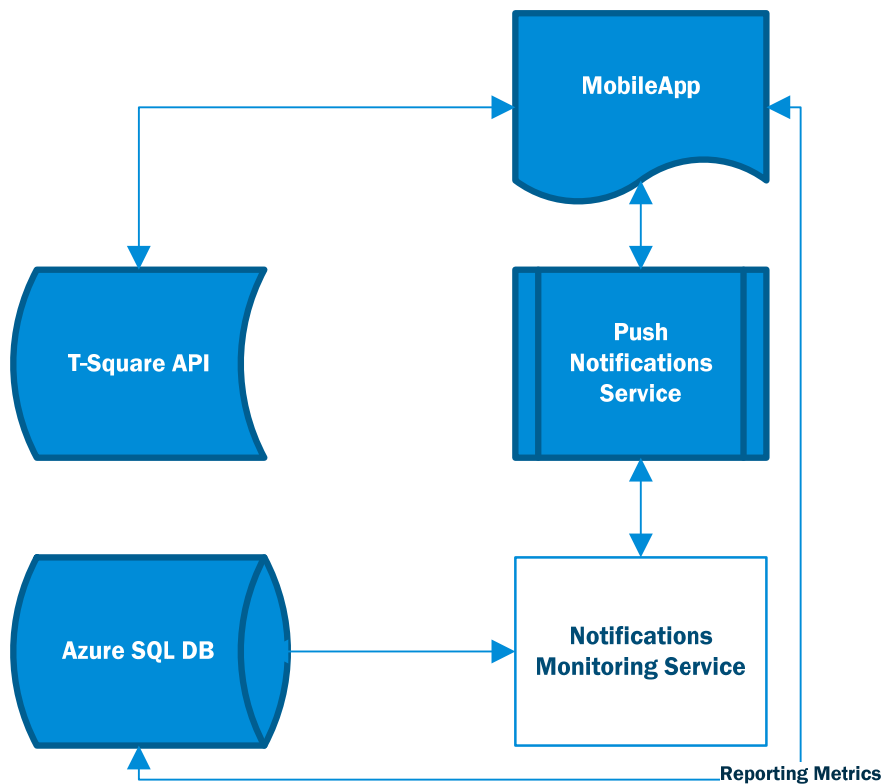


Figure 2 New Mobile App Architecture

<sup>4</sup> Georgia Tech’s Online Master’s in Computer Science program.

It will be tied into T-Square's API to access coursework and students will receive push notifications via the app, and the database will track metrics of how often students are accessing the app and reminders. The notifications will be set at frequencies I specify. If the sample size is large enough, I may vary the frequency of the notifications and tone of the messages to match the original scope of the project.

## **Conclusion**

The experiments this semester were problematic. Recruiting issues, incomplete datasets, and a low participation rate in the survey resulted in smaller than expected sample size. However anecdotal evidence from survey points to the possible usefulness of reminders to reduce cognitive load. In the Spring run of the experiment, I plan on overcoming the limitations of the Fall study by switching to a potentially larger of pool of subjects and moving to push notifications which are less likely to be lost in the noise of emails.

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