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Capstone Report



SLICE
CONSULTING

METALS HCII
Spring Report
Carnegie Mellon University

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EXECUTIVE SUMMARY

Western Governors University partnered with Slice Consulting, a team of four masters students from Carnegie Mellon University, to develop a mobile application. This mobile application will assist the students of WGU achieving the learning goals of their courses. To gain a better understanding of the students and problem space, we conducted exploratory research consisting of a competitive analysis, literature reviews, interviews, flow modeling, and affinity diagramming. Following

our research, we modeled and analyzed the data to generate a set of key insights, representative student profiles, and important design considerations. These results were then used to generate a set of nine feature ideas for the mobile application. The feature ideas were iteratively refined as we gathered increasing results, which ultimately concludes in an evaluation of feature.

INTRODUCTION

CLIENT INTRODUCTION

Western Governors University

Western Governors University (WGU) is a private, nonprofit, online American university based in Salt Lake City, Utah. The university was founded by 19 U.S. governors in 1997 after the idea was formulated at a 1995 meeting of the Western Governors Association. The university uses a competency-based learning model, with students working online. WGU's accreditation is through the Northwest Commission on Colleges and Universities. WGU comprises four colleges, each offering bachelor's and master's degree programs: the College of Business, the College of Information Technology, the Teachers College, and the College of Health Professions, which includes de-

grees in nursing. Terms consist of six-month "rolling" semesters, which start for individual students on the first of every month. Classes are assigned unique terms lasting six weeks but students may proceed at their own pace. Many classes have cohorts, students working in the same general time frame, to facilitate online meetings and discussions, though students in any given cohort progress to the next course as soon as they are able to prove their knowledge. Course mentors provide both group and individual instruction as well as moderating online discussions. WGU also has student mentors who advise and guide a student throughout his or her entire degree program.

HUNT STATEMENT

WGU's most essential concern is to help students to stay in touch with the course content. Most of the students have very hectic schedules as they work full time and have other major responsibilities in life. Hence WGU wants to leverage mobile technology to increase engagement with the course content by building an application that supports micro learning or byte-size learning. Based on this description we came up with the following hunt statement for our project.

"EXPLORE STUDENT PERSONAL LEARNING DYNAMICS SO THAT WE CAN BUILD A SUPPORTING MOBILE APPLICATION IN WHICH STUDENTS CAN CONTINUOUSLY LEARN TO DEMONSTRATE SUBSTANTIVE GROWTH TOWARDS THE LEARNING GOALS OF THEIR COURSES."



RESEARCH PROCESS

Competitive Analysis

We first began our research phase by conducting a two-part competitive analysis which focused on both mobile applications at other online universities and existing educational mobile applications. Analyzing mobile applications implemented by competing online universities provided insights into what ultimately made them effective or ineffective. It also provided insights into how the students of the given university perceived the application's usefulness. In a similar vein, we wanted to see how existing third-party educational mobile applications effectively leveraged the use of learning science principles. This was used to gain design and implementation ideas constrained within a mobile device, while also helping to direct our literature review.

Online Universities



Educational Apps



Literature Review

For our literature review, we began by doing a broad overview of research related to learning in the context of a mobile application and ways to optimize time-constrained learning. From there we focused our review into these three major research areas: mobile learning, memory and forgetting, and spaced practice. Research on mobile learning literature helps to provide insights into the application of learning science principles and user-design considerations for a mobile application. Memory and forgetting are key cognitive areas that need to be addressed when dealing with retention and studying. Finally, research regarding spaced practice can be used to help inform how we can design the application to increase memory and fluency. These three research areas ultimately interact with one another and were considered as we progressed with modeling and further ideation.

27 Literature Sources

 5 Memory & Forgetting

 6 Mobile Learning

 6 Practice

 10 Other

Interviews

For our user-research, we conducted interviews with WGU students. The interviews were a mixture of both in-person and online. We interviewed 25 participants ranging 26 to 61 years in age. The degree programs of these participants included accounting, business management, mathematics, educational leadership and IT. The number of years in the program ranges from 1 to 5 years. These participants came from various industries like software, medicine, education, milk processing, e-commerce, etc.

We began by conducting a series of in-person interviews, as we wanted a more personal experience with the WGU student. After conducting 5 in-person interviews, we revised our script to incorporate new findings, and proceeded with a series of online interviews. We conducted 20 online interviews, where we revised the script as needed to focus on interesting insights that emerged.

The interview questions mainly collected information on questions related to motivation behind joining the program or studying, study habits of individuals, how tech savvy is the user and their experience with the WGU technology and WGU mentors. Each of the categories was finalized after debating and pilot testing the script.



Flow Modeling

In order to gain insights into WGU at a systems level and identify how the different components communicate with one another, we developed a flow model as recommended in the contextual design process². The model was used to understand the different entities that make up WGU in greater detail and visualize the interactions between them. We wanted to gain a better understanding of what information is being passed from each component of the WGU system. This helped us identify areas which needed improvement in which our mobile application could address. It also provided insights into which entities could be affected by having the app target specific interactions between them. Combining the flow model with our interview findings allowed us to see the participants' personal pain points in the system. From there we were able to refine our flow model and identify generalizable pain points in the greater system that the app could improve.



Affinity Diagram

After we finished conducting all the interviews, we had a lot of data to analyze. We proceeded in doing affinity diagramming³ to transform our findings into concrete and useful design ideas. We transcribed all the interviews and wrote down important facts on sticky notes in such a way that we had just one fact per sticky note. Once we started the affinity diagramming process, we grouped all the facts together into different categories. Several themes came up as we tried to sort this data. We started to see patterns as we tried to tell each other what our interviewees had to say. Once we noticed that some themes had a lot of facts under them, we tried to re-organize the sticky notes into sub themes to group all the facts more meaningfully. This brainstorming process was really useful as we came up with some feature ideas based on the 35 emergent themes. Our interviewees belonged to different age groups ranging from 26 to 61. Most of them were married and had kids. Even though our interviewees had very diverse back

grounds, different work schedules and degree programs, it was really interesting to see similarities in their study habits, work schedule, mobile usage, motivation and so on. Affinity diagramming also reaffirmed some of the predictions we had made before going into the interview process. It also brought several new facts to the surface which we hadn't thought of before such as the different course and program level strategies that the students take, the third party resources they use in addition to the existing WGU course materials and so on.



FINDINGS

THEMES FROM MODELING

Logistical Issues

Logistical issues are issues dealing with user experience not directly related to learning. This category was formed as a result of issues faced by students before they started studying. From our interviews we found evidence of user frustration related to logistical issues faced by them. Logistical issues comprise of bad UI or UX design of the website, not able to get content in certain circumstances like no internet, cross platform accessibility issues for some types of content etc.

Students learn in various settings and in various situations and our research shows that some people may be facing significant issues with it.

One of the major issues is for people who tend to have jobs that require a lot of travelling. These users often need to carry more than one device to help them access material because not all material is accessible in all platforms or devices.

For example, one user's preferred choice of device was iPad but he had to use a Windows device too because flash is not supported in an Apple device. Travelling also brings connectivity issues at times and some users have felt the need to be able to access some content offline so that they can study while travelling etc. Other logistical issue involves trying to find the content to be studied and trying to find something studied earlier.

For example a user states, "... It takes 6-8 clicks. It's just too deep." While another user said that, "it may take me up to 20 minutes looking for things that I studied earlier."

WGU Services

WGU services, as we define for the purpose of this section, are the services that WGU provides that is supposed to directly impact student's learning. This includes the course material, content and resources, student and course mentors and the WGU mobile app.

Generally speaking, our research revealed that there was a very positive experience with the course material however sometimes that tends to not be the case. Especially, in courses that involved more mathematical background users tend to behave differently while studying as well as have different expectations from the course. While the difference in their behavior will be treated in the later section of study habits, the difference in expectations will be discussed here.

Users tend to prefer a more "teach me how to do it" approach when it comes to mathematics.

The reason for this preference might be due to the fact that a lot of them have lost touch with high school mathematics and feel that they have forgotten everything. Because of this preference for methods of solving questions, the webinars that WGU provides have been found to be extremely popular among users.

The mentoring services that WGU provides its students have given us mixed results for likability and utility from the research. On the positive side, some students have really felt that mentors are helpful. For example: One student who is now doing a second degree program with WGU explicitly requested for the same mentor as the previous degree program. For those who found the mentors helpful, the utility value came from really different sources. While some students liked the fact that their academic hurdles (doubts with subject matter) were being taken care of others felt that mentors really pushed them to stay on track and stick to goals.

Some also ended up becoming friends with the mentor and they preferred to talk about things that are unrelated to the course. Thus mentors served different functions for different users and there was an element of compatibility involved in how good the relation between the student and mentor might be.

On the negative side, students felt that the phone calls were meaningless and didn't help them succeed in any way. Some users didn't talk to the mentors for a long time, and even if they did the nature of interaction can perhaps be best summarized as ritualistic or confirming to compliance issues of the coursework. The reason for the negative experience is the lack of perceived or felt need to interact with mentors.

Study Habits

This section is about trying to understand the user experience once they start studying. This section is heavily influenced by the individual lifestyle of the user and their personal beliefs in how to study.

There is a lot of diversity in how students tend to manage their studies.

In terms of studying the course material, some users prefer reading the entire book and make notes about it; others feel that it is a waste of time because it is too much material to handle at once. Some others try to do the pre-assessments first to measure how well they know this topic before jumping into the course material.

Other than course material, students use various ways to learn, remember and revise what they think is important. As mentioned earlier note making is one

of the strategies. Some are tech savvy and use apps or other tech options to manage their coursework. For instance,

some users prefer to make their own short quizzes using online technology for things they believe they need to remember in the future, while others find it hard to even pick what is important to remember in advance. There are also course level strategies wherein a mathematics based subject is treated differently compared to a course which requires essay writing. For doing mathematical courses, users refer to sites like khan academy, make extensive notes and sit down and work things out on paper.

Motivation

Most students could be broadly classified as belonging to one of the two categories of motivation. One of it is being internally motivated and signing up for the course for own satisfaction and learning while the second is the utility of the degree in facilitating career change or promotion in workplace.

Students are intrinsically motivated to expand their knowledge and extrinsically motivated to advance their careers.

In addition to these factors, WGU has made a brand for itself in the online degree providers' space and is both accessible throughout the country and quite affordable. Participants reported having researched other online options and then making a decision based on their assessment of different online university. Criteria for their assessments tended to be a mix of convenience factors and brand value of the university.

Time Management

Since a significant amount of WGU students are working professionals, time management is an important part of student performance and success. Some students' jobs allowed for much more flexibility than others.

Student schedules range from day-to-day consistency, to not having a set work schedule for the coming week.

Those who have a more mobile or relaxed work life, usually find productive time in office downtime, while others work odds shifts and rely on both internal and external sources of motivation to meet the deadlines. Yet some students who tend to be on the younger side without families are much more carefree and have all the time in the world but procrastinate instead of studying in a timely manner.

User Preferences

User preferences show a lot of diversity representative of the student population. Some users preferred a lot of technology and gave suggestions that they thought would help them. Some of them used Flashcards apps available online, including flash cards shared by previous WGU students. Some of them used pre-assessments as a way of deciding whether the unit was worth reading word to word or not. For mathematical courses users had different preferences. Users wanted either something that tells or shows them how to solve or something that gives them a more personalized feedback.

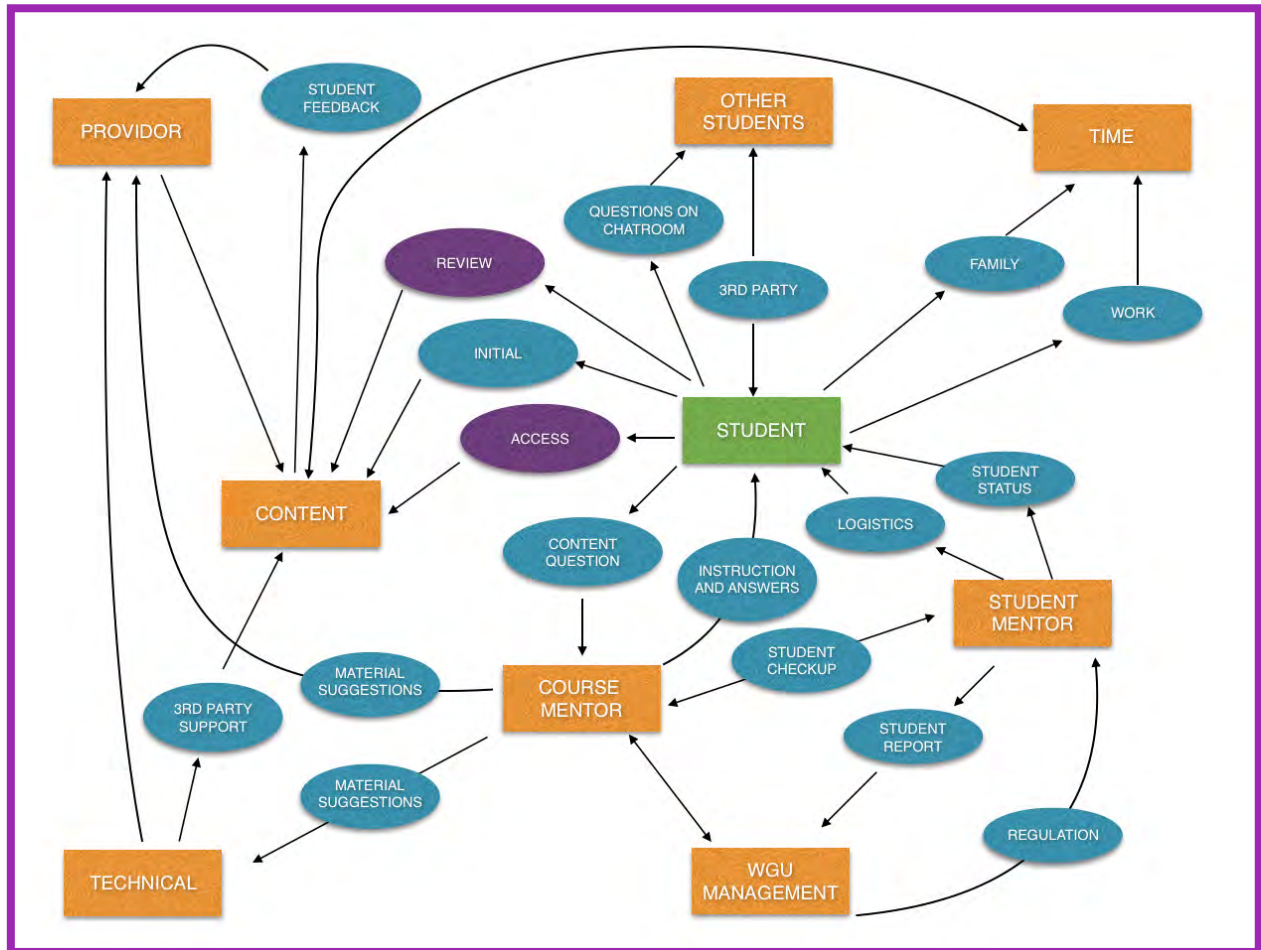
Ultimately the user preferences were dependent on the particular aspect being discussed, there was quite the range.

User preferences for social aspects of the services varied a lot. Some of the felt that they were too old to go into a chat room while others just felt that they

didn't have the time to go to the chat room. Users did express desire to have something that is more handy easy to manage and work around with. Most users' basic functionality of the app they had used so far was to store important information easily and use it later on.

Users who had a good relationship with their mentors and found their services beneficial suggested that a faster way to get your message across to the mentor will be very helpful. For example, "Something like a picture that I can share with them when I am stuck with a question will be very useful.. It is not always easy to fix an appointment in short notice." Users also had their own beliefs about what worked for them and what they should be doing if they wanted to improve. Some people were intensive readers while others did some research used learning science principles like spaced practice and interleaved examples.

FLOW MODEL



PERSONAS

Jill Anderson



"I not only want to earn a degree but I want to learn and grow in my field. I will like to do this without compromising time with my family or taking time away from my hobbies."

Age: 38 years

Work: Human Resource Manager

Family: Married with two kids

Location: Pittsburgh, Pennsylvania.

Personality



Disciplined Hard Working Positive Result Oriented
Highly Experienced

Goals

- Complete the degree as soon as possible
- Support family

Frustrations

- Technical glitches are extremely frustrating because she doesn't have a lot of time to catch up to the time lost in waiting.
- Needs someone to walk her through the solution because she has been out of touch with school for almost 20 years..

Bio

Jill is a human resource manager. She has a job and two kids to take care of. She works every day from 9 to 5 and comes back home and cooks dinner for her kids. She loves to spend time with her family. She wants and tries to study a little bit everyday so that things don't pile up. She has been out of school for 20 years and has vast job experience in her field. She never completed her degree and now feels the need to do so for professional purpose. She studies in the office downtime. On the weekends, she likes to spend time with her kids and also tries to catch up with her studies. She does not waste any time in social networking or social events.

Motivations

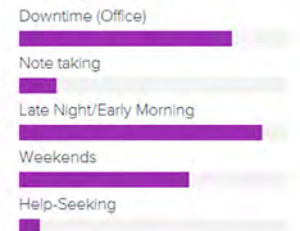


Technology

A collection or list of the user's apps.



Study Habit



Steve Harrison



"To be honest with you, I have all the time that I need. I wish I had other things to do in my life so that I would plan my studies better"

Age: 25

Work: Unemployed

Family: Single

Location: Bay Area, California

Personality



Motivated

Growth Mindset

Focused

Goals

- To complete this degree.
- To get a job

Frustrations

- Feels that the study material is not uniform in quality. Some sections are more comprehensive than others.
- Finds it hard to manage time or plan studies.
- At times, faces issues getting help

Bio

Steve did a degree in music from a community college. Steve is currently unemployed and is pursuing a degree in software engineering. He wants to finish the degree so that he can get a job. He is single and currently lives with his parents.

Motivations

Internal



Fear of Unemployment



Growth



Social



Apps

A list of the Mark's favorite app.



Study Habits

Downtime



Uses apps



Late Night/Early Morning



Weekends



Help-Seeking



Mark Richards



"Staying dedicated to it and actually making it a priority. It is very easy to say I have so much going on and I don't have time to study but that is a waste of money"

Age: 35
Work: Manager
Family: Married with two kids
Location: California

Personality



Adaptive Tech Savvy Focused
 Productive

Goals

- To learn new things.
- To get a degree for personal satisfaction.

Frustrations

- While traveling it is difficult to access material.
- Being notified about essay being reviewed causes distraction.
- Has to carry two devices because not all content is supported on one platform.
- Struggles with mathematics related questions.

Bio

Mark works as a consultant in the IT industry. He is making a lot of money and doesn't need a degree for professional purpose. He always wanted to learn new things and likes studying. His job requires him to travel a lot. He often downloads videos or materials to watch while he is in a flight. He is also very tech savvy and finds ways to leverage technology to better manage his studies.

Motivations

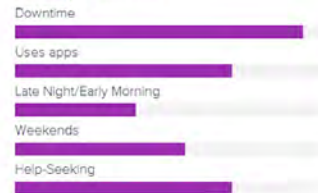


Apps

A list of the Mark's favorite app.



Study Habits

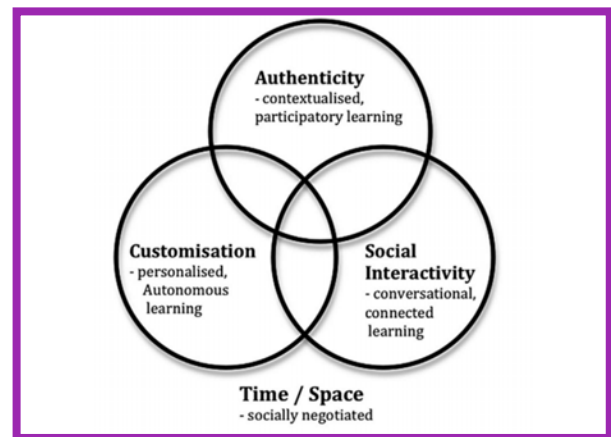


LITERATURE REVIEW

Mobile Learning

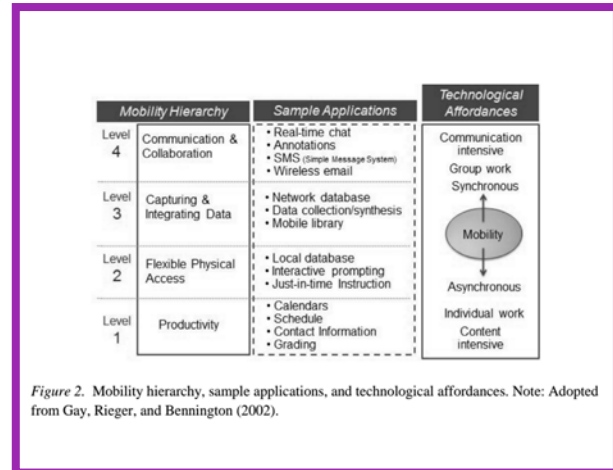
We wanted our mobile literature review to guide and expand our design thinking. To that end, we sought out research papers that provided mobile learning frameworks, meta-studies, and user pre-conceptions. We realized papers providing meta-studies and user pre-conceptions had relatively short shelf life; those ideas change quickly. However, we found mobile learning frameworks useful in the design ideation and hypothesis stress-testing phases of our process.

One particular mobile learning framework⁴ is displayed below:



The beauty of the diagram is that it framed our conversations and organized our thoughts accordingly. For example, what does a highly customizable solution look like for our app: self-scheduled push notifications for when to study and self-created quiz questions. What does a non-customizable solution look like for our app: machine-learning scheduled push notifications and Acrobatiq generated quiz questions. For such an example, the framework not only asked the question of personalization, but also the question of how a personalization solution works in tandem with other important components.

If we went with self-scheduled push notifications for study sessions, that would align with a much more authentic experience. Students are scheduling their study into the context of their life, and are taking agential action in taking control of their studies. Throughout the Spring and into the Summer, this and other frameworks will provide invaluable use.



Another area of mobile learning research we looked at gave us new insights on how mobile learning has unique technological attributes which provide positive pedagogical affordances. Gay, Rieger, and Bennington⁵ developed the “mobility hierarchy” including four levels of objectives that encourage the use of mobile computers in education settings. This hierarchy presents the contrasting attributes of mobile devices. The focus of “productivity” (level 1) is content-intensive, whereas the focus on collaboration and communication (level 4) is communication-intensive.

Level 1 aims at individual learning, and level 4 aims at collaborative learning by multiple users. Levels 2 and 3 fall into the “middle-range applications, such as personal tour guides, computer-aided instruction, database activity, mobile libraries, and electronic mail”. These levels gave us a new way of classifying our feature ideas and made us think more about the technological affordances we want to focus on in this project.

As this hierarchy indicates, mobile technology has two comparable attributes. Scheduling and calendar applications are useful to increase an individual’s organizational skills and self-regulative (or self-directed) learning ability; whereas, real-time chat and data sharing applications support communication, collaboration, and knowledge construction.

This hierarchy really influenced us when we were brainstorming new features for the application. For example, we thought about how idle reminders on the application can motivate the students and help them to stay organized (Level1). We also thought about how to increase communication and collaboration between student and their mentors and peers (Level4).

Another research study that we looked at to understand mobile learning better is by Mehdipour and Zerehkafi⁷. This study discusses the similarities and differences between E-Learning from Mobile Learning. A part of our challenge in this project is to think how different these two platforms are for learning and what are the challenges ahead of us in designing a good system.

Some of the advantages of using mobile learning are: learning can happen anywhere, anytime as it a continuous and situated learning support; improved instant synchronous one-to-one communication is possible between students, their mentors and peers; learning can be self-paced, un-tethered; devices used are more light-weight than books and computers; mobile learning can be used as a hook to re-engage disaffected youth.

This paper also talks about the challenges that come with mobile technology such as : issues about connectivity and battery life, different screen size, limited memory and so on. We had to keep several of these benefits and challenges in mind while thinking about features for our application. For example, we will leverage the communication features that a phone provides to improve student-mentor interactions and peer to peer interactions. We will also think of ways to provide offline practise to students.

Memory and Forgetting

Research on memory and forgetting has been pursued for over a century and there have been some robust results and patterns that have been established over countless empirical studies. However, these results are not known for high ecological validity as they have been often conducted in labs in controlled environments. But we still have general takeaways about memory and forgetting that can inform the way we choose to deliver learning material.

Keeping in mind the busy lives of most of the students and the problem presented to us by the clients, one of the most important phenomena of interest is retroactive interference.

Retroactive Interference is the phenomena when newly learned information interferes with the remembering of previously learned information.

This phenomenon has also been stated differently by a much older law namely Jost's law⁸, which states that if one memory was formed more recently than another, than the rate of forgetting for the younger memory trace will be higher than the rate of forgetting for the older memory trace.

Follow up research on why this forgetting happens and what is the nature of this interference has been debated for two major reasons. One theory says that this forgetting happens due to cue-overload which means that the forgetting happens if the new material is related to the previously learned material and the retrieval cue for these memories are overloaded, while the other theory suggests that the forgetting is due to trace degradation which is simply the degradation of the memory trace due to learning of new information that is related or unrelated to recently learned material.

In addition to this there is also a tempo-

ral gradient for this retroactive interference. This means that time gap between the two learning events is inversely related to the amount of interference observed. And once the memories have been consolidated into long term memories they become immune to interference altogether.

This has some important implications for our app design:

- There should be higher importance given to protecting the newly formed memories than the older ones.
- There is a need to strengthen memories to a point that they are immune to interference.

Next we will look at some of the techniques that have emerged as a useful way of countering these natural phenomena of forgetting and interference.

Practice

As our mobile application is intended to be used by students to study and practice, we set out to discover research that informs ways to make it as effective and efficient as possible. Such research pointed toward leveraging both appropriate timing and chunking of the material. In regards to timing, there are two common forms known as spaced practice and mass practice. Spaced practice is learning and reviewing the material in segments across a longer period of time, like studying over the course of a week. On the other hand, mass practice is learning and reviewing with no intervals between successive bouts, such as cramming the day before a test.

The benefits of spaced practice over massed practice have been strongly supported^{9,10}. It can increase the quality of transfer and build up the aforementioned memory and fluency¹¹. In another study, spaced practice was found to

benefit inductive and repetition learning in both young and older adults compared to mass learning¹². Because massing naturally leads to feelings of fluency and increases short-term task performance during learning, learners frequently rate spacing as less effective than massing, even when their performance shows the opposite pattern¹³. With these findings in mind, we'll need to ensure the application encourages users to spread out their practicing when they can.

Mass practice shouldn't be completely avoided either, as it's better than no practice at all.

In regards to chunking the material, research supports using interleaved practice over blocked practice. Interleaved practice is that which is intermixed, while blocked practice is that where it's grouped by type¹⁴.

Interleaving the material has been shown to improve the transfer and acquisition of tasks for individuals of all age groups¹⁵. This area of research suggests that we don't strictly group the questions by section or even course. It implies that we should vary the succession of questions at the section or course level to achieve the greatest retention benefits.

In addition to the timing and chunking of the material, repetition plays a large role in making practice effective.

Repeating testing during the learning process has been shown to enhance retention rates relative to repeated studying¹⁶. The study also found that repeated studying of previously recalled items did not benefit retention relative to dropping those items from further being studied. This reinforces the implications that we need to have students utilize the application amidst their studies. It additionally provides insights into how we

can organize the material used to practice in a manner that combats forgetting and strengthens retention.

COMPETITIVE ANALYSIS

There are two groups that we are competing against: existing apps from major online universities and general consumer learning apps.

Existing apps from major online universities aren't too distinct: a short list can describe all the features that these apps offer:

	Message Staff & Mentors	Degree Program Schedule – Past & Future Courses	Library Resources	University News & Events	Text-to-Speech	Calendar
University of Phoenix				✓		
Ashford University		✓	✓	✓		
Colorado Technical University	✓				✓	✓
DeVry University	✓		✓	✓		✓
Western Governors University	✓	✓	✓			
Arizona State University		✓	✓			✓

These app offerings are similar in the basic tooling: syllabus, grades, and assignment and course updates. It is interesting to note that little is being done to promote access to learning content besides discussion participation.

Most of the features on these are entirely logistical: contacting course managers, examining the task stream, or seeing as-

ignment updates. In that regard, there is little differentiation.

In this fact lies our excitement in delivering a competitive advantage to WGU students: a serious attempt at mobile learning from a major online university.

Looking at what makes existing, mobile learning applications successful, we noticed clear patterns:

	Bite Size	Push Notifications	Social-Sharing	Great UX	History of engagement	Gamification	Review Material
Duolingo	✓	✓	✓	✓	✓	✓	
Khan Academy	✓	✓	✓	✓	✓	✓	✓
Quizlet	✓	✓	✓	✓			
Hebatica	✓	✓	✓	✓	✓	✓	
Primer by Google	✓	✓	✓	✓	✓	✓	✓
Minute Physics	✓	✓		✓			

In our design and iteration cycles, we would source from the general principles listed above and apply them to a WGU specific app. For example, how could we ensure a great first time user experience for new installers of our app? A clear, immediate description of the capabilities and value proposition upon first open is key. Another principle we will consider is the level of gamification of the learning content. Duolingo relies on it heavily (streaks, currency, buyable outfits for avatars), whereas Primer by Google is subtle (simple badge counts).

Both of the competitive analyses show our course. From the analysis of the apps by online universities, it shows where we must innovate beyond. From the analysis of existing consumer apps, it shows the minimum bar of where we must set ourselves. We are looking forward to seeing what we can accomplish.



IDEATION

IDLE REMINDERS

“ I study a decent amount, but sometimes when I’m lounging at home I get comfortable and forget..”

Description

Activity recognition is prevalent in virtually all modern phones, as technology is able to detect when the mobile device is idle or on the move. With the use of Idle Reminders, the app detects when the user is idle at home and reminds them to study! The user can set custom and personalized reminders to help keep them motivated, while also helping to curb habits of procrastination.

Themes and Research Areas

- » **Personality**^{t14}
- » **Time**^{t2}
- » **Motivation**¹⁸



Aditya has a really hectic work schedule and can't manage his WGU study work effectively. He is lagging behind in the course and is procrastinating a lot.



Idle Reminders feature of our app detects when Aditya is sitting idle at home and it sends a push notification on his phone to remind him to study.



Aditya really likes these personalized reminders and feels motivated to use his free time to review a few topics before dinner.

Evaluation

Providing the user with reminders isn't what makes this novel, it's that the feature learns the user's activity habits and reminds them during their noted idle times. Taking advantage of time that may have otherwise been spent not studying and turning it into valuable learning time. This increases the impact of the feature, but at some cost to the user's experience. There's a potential for users to disable said notifications or just disregard them entirely.

Rating



CLEAR VIEW

“ Sometimes it’s just that I don’t understand the way they worded it.. ”

Description

Clear View addresses the problems that occur when a user doesn’t understand the underlying concept of a question. When this happens, the user has several options to clarify their confusion. With Clear View, they can send the question to one of their friends or mentors to gain clarification. Mentor responses will be sent to their existing WGU email and the app’s inbox feature. Alternatively, they can add the question and an accompanying clarifying note to a list. These lists

are created by the user or they may utilize the default ones, which are organized by course unit. Users can then view their list(s) of questions in preparation for tests, etc.

Themes and Research Areas

- » **Mentors**^{t6,t7}
- » **Mobile Learning**^{t19}
- » **Notes**^{t24}



Halida is really confused about a question on the app. She wishes that she could clarify her doubts with the mentor without having to wait for her next mentor meeting.



Clear view feature of our app helps Halida to add a clarifying note to her question and send the question to one of their mentors.



The course mentor emails Halida and provides more clarity on the questions she was confused about. Halida is happy that she understands the concepts better now.

Evaluation

This feature helps to improve clarity and communication problems that often occur while studying, as such the user's experience is greatly benefitted. The clarification the user can gain from this feature promotes the building of accurate mental models, increasing the impact. In general, a method of asking questions about a question or concept isn't too new. Being in the context of a mobile app and being able to select the different recipients does add to the novelty.

Rating

Novelty



Feasibility



Impact



User-Experience



SKYNET

“ I have Hangouts and Facebook, I don't know why...”

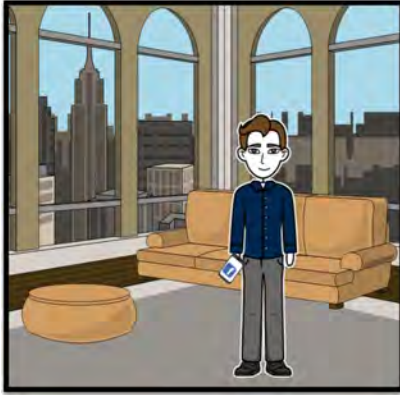
Description

Being productive can often be challenging in a world surrounded by the constant temptations of entertaining and engaging technologies. Through the use of Skynet, the temptations of the mobile world can become integrated with user's studying. Skynet detects when the mobile device's user is procrastinating, such as continual browsing of Facebook. User procrastination patterns are learned as they interact with their phone with the app installed. It then interjects the occasional question overtop the current application being run on the phone. The

questions come from the user's current course progress and adaptively syncs as the user progresses. User study habits should begin to improve from the positive punishment Skynet provides.

Themes and Research Areas

- » **Personality**^{t14}
- » **Procrastination**^{t20}
- » **Positive Punishment**¹⁷



Andrew spends a lot of time on his phone to access social media applications. He can easily use this time to study instead.



Skynet feature of our app detects when Andrew is not being productive and interjects an occasional question overtop the current application.



Andrew realizes that he should be studying instead of wasting time on social media.

Evaluation

While Skynet is fairly novel, the impact such a positive punishment feature might have is dependent on the user. With the user's phone being obtrusively controlled, if the interventions weren't timed accordingly, the experience would likely be hindered to the point of them refusing to interact with the app. However, with proper timing the feature has potential to curb the user toward less procrastination and improved study habits.

Rating

Novelty



Feasibility



Impact



User-Experience



SELF-EXPLANATION

“ *The only thing I struggle with is my own way of thinking..*

Description

Apart from retrieving facts and checking concepts, there are times when students need to know a certain process. Conceptual change happens through reassignment of category and forming new representations. That's where Self-Explanation comes in, as it helps users build knowledge even when no active feedback is given. Users are prompted for self-explanation after answering a question, helping them to make coherent mental models. Additionally, this

data can be used for analytical purposes to see any notable differences in low vs high performers.

Themes and Research Areas

- » **Study Habits**^{t8}
- » **Deep Learning**^{t16}
- » **Memory and Forgetting**^{20,21}



Kathy keeps answering questions wrong on the circulatory system.



A self explanation prompt appears on our app screen after Kathy answers a question. While filling in the details, Kathy realizes that she had a misconception.



Kathy feels happy that she understands the material better now after having a chance to explain the concept to herself.

Evaluation

This feature can be a powerful one if the user elects to complete it. Research has proven that self-explanation is effective in helping students build up their mental models. However, the timing of this intervention and motivating students to actually do it remains a challenge. Self-explanation isn't novel on its own, but in this mobile context that allows for alternative ways of inputting the self-explanation, it gains novelty.

Rating

Novelty



Feasibility



Impact



User-Experience



HINTS

“ Sometimes I get stuck on one of the pre-assessment questions and get SO frustrated...”

Description

When a user gets stuck on a question, they can become frustrated which can lead to them ending their study time. This can create a missed learning opportunity or it may cause users to fill in-correctly fill the gaps in their knowledge, creating a misconception. With the use of Hints, each question will have a helpful message the user can use to guide them toward the correct answer. Through the simple click of a button, the user will be presented with a pop-up containing the

guiding message. User metrics can also be gathered for each question, monitoring which questions the hint is used for the most, thus signaling an area that needs improvement.

Themes and Research Areas

- » **Study Habits^{t12}**
- » **Mentors^{t6,t7}**
- » **Help Seeking¹⁹**



Noah is really confused about the correct response while answering a question on the app.



He clicks on the "Hint" button.



Noah quickly remembers the correct answer and moves on to the next question.

Evaluation

The use of hints in some fashion are common in many games, applications, etc. that require user input, thus the novelty is minimum. However, the use of hints is so prevalent because they're both easily implementable and effective at guiding at the user. Hints can be impactful by helping the user gain clarity on any misconceptions they have while also allowing them to progress through the app.

Rating

Novelty



Feasibility



Impact



User-Experience



SCHEDULR

“ I like to set mini-goals for myself that I know I can achieve, they keep me going...”

Description

Time management is a problem for many students, there just aren't enough hours in the day. Finding time in one's busy schedule to study can be quite the challenge, but having time to study is crucial. Through the use of Schedulr, users can plan their studying time and set goals to achieve during the coming days, weeks, and months. The user receives reminders regarding upcoming study times and achievement goals they've set. A user's student mentor may also view

their upcoming goals set in Schedulr, so that they can help keep them on track. It's also capable of being integrated with the popular calendar apps, so the user can easily plan all their events.

Themes and Research Areas

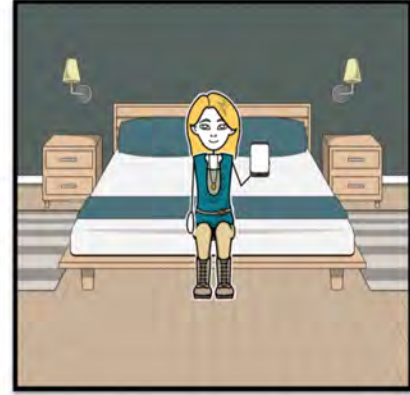
- » **Mobile Learning**^{t19}
- » **Self-regulation**^{t2}
- » **Time Management**^{t4}



Taylor is a WGU student who works full time at a hospital as a nurse. She finds it a little difficult to make an agenda for the week to study.



Schedulr feature of our app helps Taylor to effectively plan her weekly study goals. She can also share these goals with her student mentor who can follow up with her during the mentor meetings.



Taylor feels happy because she is able to manage her time much better and has the flexibility to set her own weekly goals.

Evaluation

This feature is supposed to help students become more self-regulated. It is a very useful feature to have for students who are fairly good at self-regulation yet need help in improving their habits. It gets a low score on UX because of the added effort of setting goals which might not appeal to all students.

Rating

Novelty



Feasibility



Impact



User-Experience



FLASHCARDS

“ I like to create my own flashcards, but don't have an easy way to do so on the site...”

Description

Utilizing flashcards to study has been around for quite some time and remains quite the favorable way to review material. While there are options for creating flashcards digitally, they fail to keep up with the busy and mobile lives of people in this current age. Using Flashcards, users can easily create flashcards from the material provided to them from their current course(s). Through a simple process of highlighting the material, clicking a few buttons, and writing optional text,

the user can easily generate hundreds of flashcards. They also seamlessly sync up to the cloud, for continued use on virtually any digital device.

Themes and Research Areas

- » **Memory**²⁵
- » **Retention**^{t16}
- » **Study Habits**^{t8,t18}



Priyanka is a WGU student who is pursuing a master's degree in Mathematical Science. She has trouble practicing and remembering all the important terms and formulae for her upcoming final exam.



Priyanka can create her own flashcards on our app for terms and formulae apart from the ones WGU already provides to her. She can pin each flashcard and add it to a custom list to review it later.



Through repeated practice, Priyanka is able to remember all the important terms and formulae and ace her exam.

Evaluation

This pitch is certainly not new idea, but from our research we found that it has great utility as a lot of students used flash cards. We believe that in terms of learning flashcards may have good but limited impact because of the limited nature of the content it can cover. However, that is not a big limitation as flash cards serve a unique function.

Rating

Novelty	★☆☆☆☆
Feasibility	★★★★☆
Impact	★★★★☆
User-Experience	★★★★★

MULTI-SENSORY

“ I like things to be hands-on, I want to be able to feel it when I’m learning about it...”

Description

Receiving feedback is a key component of the learning process. Engagement is also another aspect that can hinder learning when it’s not being properly addressed. Through the use of Multi-Sensory, both of these areas are not just used, they’re combined for an exceptional experience. Multi-Sensory provides the user with feedback targeted at their auditory and physical channels. Incorrect responses trigger a sound and vibration from the mobile device. These added vibrational

features can also be utilized to create new question types. It allows the user’s mobile device to target channels rarely and often ineffectively targeted by existing educational applications.

Themes and Research Areas

- » **User Design**²²
- » **Engagement**²³
- » **Memory and Forgetting**²⁴



Rachel becomes disengaged and bored as she continues to answer questions on her phone.



Rachel receives physical feedback in the form a vibration, which jolts her into paying attention.



Later on, when Rachel takes a test, and sees a similar question, she quickly recalls how the phone vibrated and made a sound when she answered the question incorrectly. Thus she remembers the correct answer.

Evaluation

The idea is extremely implementation friendly, but may not have a deeper impact beyond feedback of the primitive type. This app feature is not designed for cognitive level targeted feedback. Because of individual differences in preference for different modalities in feedback, the user experience may suffer. The feature at it's base-level may not be novel, but it does open the possibility for novel question types to be utilized.

Rating

Novelty



Feasibility



Impact



User-Experience



QUIZ OFF

“ I play games on my phone all the time, I’d say I’m a fairly competitive person..”

Description

Mobile games have been dominating the entertainment industry for the past several years. It seems everyone with a smartphone has at least one game they occasionally play on their phone. With Quiz-Off, users can satisfy their urge to have fun playing a mobile game, while also incorporating valuable study time! Quiz-Off is a mobile game where students face off against one another in a one vs. one trivia-style game. The content for the game comes directly from the student’s current progress from the course(s) they’re currently enrolled

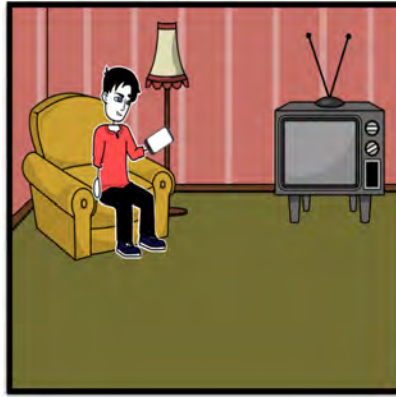
in. They’ll always have someone to play against too, as Quiz-Off uses an advanced AI, disguised as a human player, when no real players are available.

Themes and Research Areas

- » **3rd Party**^{t34}
- » **Engagement**^{t20}
- » **Study Habits**^{t21}



Joey really enjoys playing games on his phone. But he often gets distracted by them while studying.



Joey uses the Quiz Off feature of our app to study WGU material in a fun game format where he gets to challenge another player.



Joey feels happy that he gets to study and play at the same time.

Evaluation

There is no shortage of gamified education apps but most of them target younger audience. This app gets a low score on feasibility because different types of course content may require different game design. The idea is relatively high on novelty because most gamified apps are meant to target much younger audience.

Rating

Novelty



Feasibility



Impact



User-Experience



OUTRO

SLICE CONSULTING

We are a group of 4 Carnegie Mellon students who are pursuing the Masters in Educational Technology and Applied Learning Science (METALS) degree at the Human Computer Interaction Institute. METALS culminates with a capstone project that is the focus of the spring and summer semesters. In this seven-month project for an external client, students apply the techniques, theories, and methodologies that they have mastered in the program to deliver a final prototype for their client.

Students gain practical experience while they work with faculty and industry mentors in a team-based research and development project.



Steven Moore



Title
Coordinator

Skills
Full-stack Developer, Mobile Development, User-Centered Design, Educational Research

Electives
Crowd Programming, Modeling Discourse, Personalized Online Learning

Background
B.S. in Computer Science, Georgia Tech

David Hwang



Title
Developer

Skills
Full-stack Development, User Interviews, Contextual Inquiry

Electives
Learning with peers, Cognitive Science for HCI, Graph Theory

Background
B.S. in Computer Science, University of California, Davis

Shailja Relwani



Title
Designer

Skills
Full-stack Developer, Mobile Service Design and Development, User-Centered Design

Electives

- Cloud Computing, Distributed Systems, Web App. Development, Crowd Programming, Interaction Design, Mobile Service Innovation, Designing Human Centered Software

Background
B.S. in Computer Science, Carnegie Mellon University

Samyak Shah



Title
Researcher

Skills
Education Research, Cognitive Psychology, User Research, Cognitive Task Analysis

Electives
Scientific Research In Education, Data Pipeline

Background
MS in Cognitive Science, IIT Gandhinagar, India

LOOKING FORWARD

We started off the year with our hunt statement:

"Explore student personal learning dynamics so that we can build a supporting mobile application in which students can continuously learn to demonstrate substantive growth towards learning goals of their courses."

Thus far we have done much to explore WGU students' personal learning dynamics. Though we found an extreme diversity in the tools students used, their underlying motivations were patterned.

Key Findings from Modeling were:

- Logistical Issues
- WGU Services
- Study Habits
- Motivation
- Time Management
- User Preferences

Moving forward we are eager to iterate. We are eager to leverage our key findings thus far, and stress test our assumptions along the way.

Our evaluations for any prototype will be centered around the key deliverables outlined in our hunt statement:

1. **Continuously learn:** does the prototype fit a mobile first use case? Are we truly delivering learning on-the-go?
2. **Substantive growth:** are we tightly integrating learning science principles in our app, without detracting from a first-class user experience?

We are excited to start building!

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APPENDIX

35 Themes from Affinity Diagraming are:

1. Accessibility and Flexibility: Students at WGU love the flexibility that the program provides when it comes to deciding the duration of the degree and deciding how many courses to complete in a term. Since the students have a really hectic schedule, they preferred to enroll in an online university over a traditional one. A student mentioned that she had the option to take fewer courses when she met with a car accident and WGU was very open to making the necessary changes in her study plan.

2. Allocated Time: Most of the students have an allocated time for WGU in their schedule. Some prefer to use their lunch hours and evening times to study during the weekdays, some prefer to study for several hours on the weekends and some do a mix of both.

3. Short Bursts: Some students reported that they have taken every single opportunity to study even if the duration of study was very

short (5 minutes to 2 hours). They feel that they can find time at work to study, to go through some study material and get an overview of the topic.

4. Time Management: Some students use calendar apps to better manage their time. They have a pretty good idea about their schedule as it doesn't change majorly.

5. Deadlines: Several WGU students reported that they didn't have any issues with meeting deadlines and completing work on time. An interviewee said that it would be nice to have a system at WGU that lets you set personal goals and check things off once the goal is completed.

6. Course Mentors: Several WGU students reported that they haven't felt the need to contact course mentors that often. A few interviewees gave some amazing feedback on the help and support they received from the course mentors.

- 7. Student Mentors:** Most of the WGU students reported that they find the student mentors really helpful, supportive, accommodating, friendly, consistent and motivating.
- 8. Beliefs on the science of learning:** Some students believe that re-reading and re-writing material helps them learn better. Practice and interleaved recall, putting learned knowledge into practice helps them in learning.
- 9. Career Development and change:** Some students are pursuing the degree at WGU to change positions or change jobs, some find the degree necessary for their current job requirements and some just see career advancement as the main motivation.
- 10. Course level strategies:** Some students reported that they try to find knowledge gaps by taking the pre-assessment tests before starting a course. Several students reported that they like taking notes and use flashcard apps.
- 11. Program level strategies:** A few students reported that they have switched degree programs before because they were afraid of failing the certification test or because they didn't feel like spending time on something they found pointless.
- 12. Affect:** Some students at WGU jump from one course to another if they find a particular course too difficult.
- 13. Intrinsic Motivation:** Students reported that they are really interested in the program they are enrolled in and wanted to be more efficient and advanced in their field of study.
- 14. Personality:** Most of the students we talked to didn't classify themselves as procrastinators as far as getting WGU work done. They sounded very motivated and task oriented. However a student said that he struggles to do multiple courses, especially certification courses at the same time.
- 15. Social:** Some students reported that they weren't that interested in getting to know other students in the class as they have a well established friend circle both at work and outside of work in their life. Some interviewees have used WGU's webinar and chatroom features a few times whenever they got stuck with some issues.

16. Memory: Students reported that their retention of material isn't very good. They tend to forget things if they don't get to practice it in their daily life very often. An interviewee said that he feels that it's not important to remember everything but it is important to remember "where to go for help".

17. Feedback: A few students reported that the feedback they received on some assignments wasn't very clear. Students value accurate and timely feedback a lot.

18. Internet Connectivity: Most of the students have easy Wifi accessibility. Some interviewees said that they would to access content offline when they are away from the country or at a conference.

19. Mobile Learning: Some students haven't used mobile for learning before. However some reported that they have used some mobile learning applications before such as: Khan Academy, Jeopardy, Make Quizzes, GRE , Crucial Exams, WGU, flashcard apps, memory trainer apps, youtube videos and so on.

20. Apps I use during a break : Email apps like gmail, outlook , chrome, instagram, snapchat, facebook, WGU app, google keep, browser and so on.

21. Times I look at my phone: Some students check their phones whenever they feel like taking a break at work or at home.

22. Mobile Platforms used: Android, iPhone, and Windows

23. WGU app: Several students reported that they haven't used the WGU mobile app. A few students who have used the app before gave some constructive feedback on how to improve the layout and functionality of the mobile app.

24. Notes: Some students reported that they take electronic notes while studying on platforms like OneNote, Notepad or e-reader apps which can help you to highlight and annotate. Some students don't like to copy paste lines for notes but instead prefer to write them to enable better memory retention.

25. Practice Tests: Some of the interviewees reported that they take the pre-assessment tests before starting the course and only go back to read material for the sections they really struggle in. These tests help them to analyze their strengths and weakness and help them to plan their strategy for study.

26. Research Papers: A few students reported that they had to write many research paper reviews or do essay assignments.

27. Study Location: Some of the study locations that the students prefer are: home, work place, library and bars. These places vary from being quiet to semi quiet.

28. Warm Ups: Some students like to get the overview of the course first before going into in-depth study while others like to take the pre-assessment tests to test their skills. A student reported that it would be nice to have a “welcome call” before the course begins where the students gets to know “this is what we are going to do” and “this is what we are going to accomplish”.

29. Webinars: Some students reported that they haven't used webinars at all before while some others said that they found them really useful as they get to interact with the course mentors. A student reported that she uses “join.me” to interact with her student and course mentors on a one-to-one basis. A lot of students probably don't know that video conferencing with mentors is an option.

30. Content Access: Several WGU students use a desktop computer or a laptop to access the existing WGU course material while a few students

have used the WGU mobile app to access content. An interviewee had expressed a need for content to be available in audio format too. A few students expressed frustration of using an iPad for accessing videos because the content sometimes wouldn't load.

31. User Interface/ User Experience: Some WGU students reported that they faced browser incompatibility issues when they tried to access some of the course materials. Some students felt that the number of clicks required to access the course contents can be reduced and the course resources/tips pages should be made more easy to locate. They expressed some concerns regarding the different layouts of the page for each of the third party vendors that WGU currently uses to deliver content.

32. Current WGU course media (pros): Students feel that WGU's course material is sufficient and they don't feel the need to look for other resources. Students take two types of courses: i) with assignments and a final exam at the end ii) with assignments/tasks but no final.

33. Current WGU course media (cons): Some students feel that there is a lot of text to go through and it's difficult (time wise) to write down the key terms for a topic. For the assignments/tasks style course, a student felt that the tasks could be more related to each other. Students also expressed concerns about browser incompatibility issues and the content presentation variations across the different third party vendors that WGU uses.

34. 3rd party resources: WGU students use a lot of 3rd party resources along side the material that is provided to them. Some of these resources are : Khan academy videos, google, Math for dummies, Wikipedia, audio books, Quizzlet app, old study material from previous degrees, Panopto videos, Ucertify, Cerego flashcards, youtube videos, lynda.com and so on.

35. Feature Suggestions: A lot of interviewees gave us constructive feedback by giving us feature suggestion for our mobile app. We have tried to incorporate a lot of their suggestions in our feature suggestion list.

