Students' Self-Efficacy with Mobile Technology and Usage of the Learning Management System (LMS) Mobile Application

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Abstract

College students increasingly use mobile devices for coursework, and Learning Management Systems (LMS) have developed applications to meet their needs. This pilot study tested a process to explore the influence of students' self-efficacy with the use of mobile learning technologies. A purposeful convenience sampling of college students who use the mobile application of their institution's LMS (Canvas) was studied with a mixed methods methodology. To quantify mobile self-efficacy, we adapted the Computer Self-Efficacy Measure drafted by Compeau and Higgins (1995) similar to Mahat et al. (2012). We also measured the frequency of student application usage, for what purposes they access it, and preferences between the mobile application and website in completing specific tasks. Semi-structured interviews were conducted to ascertain how participants use the application in real time. Results provided a glance of the students' mobile self-efficacy, mobile application usage behavior, and indications for future research.

Introduction

With the growing prevalence of mobile technologies, Learning Management Systems (LMS) have developed applications to meet user needs[1]. College students increasingly use devices for learning, partially due to the expansion of accessible network connections (Qashou, 2021; Yang, 2012). Within the context of e-learning, this new methodology has been labeled as M-learning (mobile learning) and has seen exponential growth in academic institutions across the World (Mahat et al., 2012; Qashou, 2021). This study explores the influence of students' self-efficacy mobile technology use in the adoption rate of M-learning, including whether specific characteristics impact this behavior.

[1] For examples, see Canvas LMS: https://www.instructure.com/higher-education/products/canvas/canvas-lms, Blackboard LMS: https://www.blackboard.com/teaching-learning/learning-management/mobile-learning-solutions, or Moodle LMS: https://docs.moodle.org/401/en/Moodle_app

Problem Statement

Alrasheedi et al. (2015) identified numerous studies about the increase in student use of mobile learning technologies. An important finding of Alrasheedi et al. (2015) is that students have not been adopting M-learning as quickly as expected despite this rapid growth in the technology. The adoption rate by institutions of higher learning is inconsistent, the frameworks and research approaches are varied, making it difficult to identify the true scope and factors that affect adoption of M-learning in different contexts. Some studies focused on learner profiles, while others focused on geographical areas or device type (Alrasheedi et al., 2015). Others revealed user issues, such as anxiety about using the devices or frustration with the technology, as factors that discourage using these learning applications (Yang, 2012). A first step in addressing this problem is identifying specific users and exploring factors instrumental to adoption of these devices for coursework (specifically their use of Learning Management System (LMS) applications), with consistent tools and theoretical framework.

In examining these factors, we first concentrated on the students' self-efficacy with the technology, and how their perceived self-efficacy impacted adoption of LMS applications (Yang, 2012). Using self-efficacy as a theoretical framework was important because, in addition to students becoming familiar with the platform and characteristics of e-learning, they face different challenges utilizing these devices than with computers, such as smaller screens, limitations in storage capacity, or inconsistent Internet connectivity (Banimahendra & Santoso, 2018). Our goal was to pilot a questionnaire with a small sample of students, assess and improve it, then apply it to a more representative sample.

Theoretical Framework

Self-efficacy is a framework used in previous research on M-learning and refers to a person's confidence in their performance, or "the belief of being able to control challenging environmental demands by means of taking adaptive action" (Schwarzer, 2014). Self-efficacy relates to Social-Cognitive theory, and it has been applied to technology behavior studies like the Technology Acceptance Model (TAM) (Igbaria & Iivari, 1995). Albert Bandura's work with self-efficacy describes an individual's "perceived abilities to attain the standard they have been pursuing" (588) which can be applied to technology usage. Using a self-efficacy framework, we addressed the students' perception of their ability to use the mobile LMS effectively. Igbaria and Iivari (1995) stated, "those individuals who distrust their capabilities are easily discouraged by failure, whereas those who are highly assured of their efficacy for goal attainment will intensify their efforts when their performances fall short and persevere until they succeed" (p. 588). Our study explored students' perceived self-efficacy and how it impacts their mobile LMS application usage. The students' different uses of the application might be related to their perception of how well they can accomplish those functions. According to Bandura's framework, self-efficacy helps explain student-motivation effects in mobile LMS usage and their behaviors (Bandura, 1982; Igbaria & Iivari, 1995).

Research Questions

1. What is the relationship between higher education students' mobile self-efficacy and their Learning Management System (LMS) mobile application usage?
2. For what purposes are students utilizing the mobile application, and how do these vary based on students' mobile self-efficacy?

Hypotheses

H_{01}: The usage of the LMS mobile application by college students has no correlation with their mobile self-efficacy.

H_{a1}: The usage of the LMS mobile application by college students will be positively correlated with their mobile self-efficacy.

H_{02}: Those with higher mobile self-efficacy are as likely to use the application for more complex tasks as those with lower mobile self-efficacy.

H_{a2}: Those with higher mobile self-efficacy are more likely to use the application for more complex tasks.

These hypotheses proposed a relationship between students' mobile self-efficacy and their usage of an LMS application. Evidence for the validity of these hypotheses can be found in previous research.

The first hypothesis posited that students' mobile self-efficacy is positively correlated with their utilization of the LMS mobile application. Many studies have drawn similar conclusions regarding self-efficacy and other technology usage. According to Igbaria and Iivari (1995), individuals with a higher degree of self-efficacy exhibited higher levels of computer usage. Also, Stylianou and Jackson (2007) show higher levels of self-efficacy associated with higher e-commerce usage. Therefore, it is reasonable to suggest that mobile self-efficacy correlates with using an LMS application.

The second hypothesis suggested that learners with higher self-efficacy are more apt to utilize the LMS application for more complex tasks. This notion is supported by prior research. In the book *Self Efficacy: Thought Control of Action*, Ralf Schwarzer (2014) states, “People with high self-efficacy choose to perform more challenging tasks” (p. ix). Furthermore, Bandura

(1982) indicates that individuals with higher levels of self-efficacy are more likely to exert greater effort to complete a task. Thus, it is reasonable to suggest that mobile self-efficacy correlates with LMS application usage for more complex tasks.

Methodology

This study used a purposeful convenience sampling method to survey college students enrolled in a course requiring access to the institution's learning management system, Canvas. A sample (n=7) was asked to review a short description of the study and provide informed consent to participate.

Participants received a link to a digital version of the measures utilized in the study and were asked to submit their responses within a week. An online interview followed completion of the surveys.

This study leveraged mixed methods methodology to gather and analyze the data. Mixed methods involve collecting, analyzing, and interpreting data using both qualitative and quantitative methods to investigate a research problem. Mixed methods research is not simply the combination of qualitative and quantitative research methods, but rather a research design that integrates the two approaches in a way that enhances the strengths of each and minimizes limitations (Creswell & Clark, 2017).

To quantify mobile self-efficacy, we adapted the Computer Self-Efficacy Measure drafted by Compeau and Higgins (1995) similar to Mahat et al. (2012). Items were reworded to remove mentions of computer software and instead point to M-learning as in the Mahat et al. (2012) article. For each item, respondents indicated whether they could use the application under the condition described by marking "yes" or "no." For each item where a "yes" was specified, respondents indicated how confident they were utilizing the application under that specific

condition. Answers were based on a 10-point scale, with a value of zero for any “no.” The total score was obtained by summing the numerical values assigned to each participant's responses.

An additional survey instrument measured the frequency of student application usage, for what purposes they access the application, and preferences between the mobile application and website (or desktop interface) in completing specific tasks. Students responded on a 10-point scale to document the frequency with which they utilize the mobile application. Questions asked students to indicate whether they typically use the mobile application or website to complete specific tasks and which they prefer for these tasks. Two open-ended questions were also included. Additional questions assessed the demographic characteristics of each participant.

Finally, semi-structured interviews were conducted with participants to ascertain how they use the application in real time. Participants were asked to explain their feelings about the application’s features and if it meets their needs to engage in their courses. Students’ screens were recorded throughout the interview, allowing researchers to review these recordings to ascertain exactly how the application was being utilized.

Data Collection and Analysis

The data was first analyzed using descriptive statistics to summarize participants' responses to the survey questions. One user did not complete the self-efficacy items, and thus, this user’s responses were excluded from quantitative analysis. Total mobile self-efficacy scores were obtained by totaling the Likert-scale responses from the six mobile self-efficacy items. Regression analysis was conducted to test the relationships between calculated total self-efficacy score and frequency of application usage. Next, we aimed to determine if significant differences existed in total self-efficacy and frequency of usage across demographic groups such as gender, age, race, and preferred device. ANOVAs were used for these calculations. Additionally, four

MANOVA tests were conducted to determine the degree to which gender, age, race, and preferred device affect differences in total self-efficacy and frequency of usage and the interaction between these two variables.

According to Stanton (2006), the completion of a hierarchical task analyses (HTA) aids in the assessment of task complexity, as the sub-goals and associated plans that trigger them are encompassed within higher-level goals and plans. As a result, the intricate nature of tasks within systems can be thoroughly analyzed and described. Therefore, regarding task complexity, we generated HTAs based on each task identified in the survey. We then identified each task as low, moderate, or high complexity based on the number of steps in the task analyses and the level of cognition required for completing each task. Next, we grouped individuals based on the most complex task they completed using the mobile LMS application. Each group was given a numerical score, with one representing the users completing low-complexity tasks, two representing moderate complexity, and three representing high complexity. We used regression and ANOVA to investigate the relationships between total self-efficacy and the numerical identification of task complexity. Finally, a multiple regression analysis was performed to determine the impact of task complexity and total self-efficacy on frequency of usage, while controlling for the effects of other variables.

Qualitative analysis was leveraged to identify common themes and patterns in participants' responses to the open-ended questions and answers provided in interviews. By conducting virtual recorded interviews as the seven participants used the application, we examined how these college students applied their knowledge of the technology, focusing on the degree of self-efficacy, and how perceived self-efficacy and familiarity with the application impacted adoption of the Canvas LMS application. A qualitative analysis of the interview

transcriptions was performed using Nvivo 14 software. We created a codebook and first coded the interviews individually, then refined codes as a team (Appendix F.)

Table 1

Research methodology table

Research Question	Research Method	Data Collection Instrument(s)
What is the relationship between college students' mobile self-efficacy and their usage of the mobile application of the Learning Management System (LMS)?	Surveys Interview	Mobile Self-Efficacy Measure (quantitative) Mobile Application Usage Survey Instrument (quantitative and qualitative)
For what purposes are students utilizing the mobile application, and how do these vary based on students' mobile self-efficacy?	Surveys Interview	Mobile Self-Efficacy Measure (quantitative) Mobile Application Usage Survey Instrument (quantitative and qualitative)

Delimitations and Limitations

This pilot study investigated if there was a correlation in self-efficacy for mobile LMS application usage among college students, limiting the generalizability of the findings to other populations. The sample consisted of only seven participants, but this study is a first part of a larger project allowing us to test the instruments and technology to establish a future study with a more representative sample.

This study did not consider variables such as prior experience with technology, quality of mobile application, network speed, and technical support on adoption rates of M-learning, nor were the limitations resulting from different instructors' course sites. Only the Canvas mobile LMS application was used, so the results of this study cannot be generalized to other M-learning

applications. This study remains valuable as it offers insights into understanding the factors influencing student behavior around the use of mobile LMS applications.

Description of Participants

Participants were recruited from universities via student email lists. Researchers then contacted respondents to provide surveys and schedule interviews.

Table 2

Demographic Characteristics of Participants

Gender	Number
Male	3
Female	3
Non-binary	1
Age	
18-24	2
25-34	4
35-44	1
Race	
White or Caucasian	4
Hispanic or Latino/x/e	1
Both White or Caucasian and Hispanic or Latino/x/e	2

User Experience

As part of this study, we also aimed to understand the positive and negative experiences users had with the mobile application as well as how these experiences differed from the web or desktop-based interface. During interviews, participants were asked to do a live demonstration. and asked to expand on positive and negative experiences using the application.

Positive User Experience

Most participants liked the convenience of checking information "on the go" when unable to access a computer. Several emphasized that they enjoyed having flexible access to the application and course content as their mobile devices were always with them. Some said they liked listening to videos or audio when outside or reading course presentations during commutes to the university.

> [What] I like doing on my phone is when we have all those articles to read or course content that's maybe a video with a bunch of text. I like to open that in the mobile application on my phone, because then I can lay down and read. And I kind of like just scrolling through it at my leisure. (Participant 1)

Participants also enjoyed that the application is very user-friendly and allows them to stay logged in all the time. This did not occur on computers, which prompted them to log in every time, a time-consuming step. Referring to the desktop version, compared to the application, Participant 3 said, "I don't really log in to check my grades that much, mainly because it's just easier to, like, not have to log into [the application]." Most liked the calendar feature, stating that it was very convenient and helped keep them organized. "So I was able to just create that event right from my phone. I really like that feature … That's always… really helps to keep organized and prioritize, you know, what I need to do next" (Participant 2).

Negative User Experience

Most participants did not have many issues with the application. They said it was very well-designed and performed as expected. However, while many enjoyed reading materials on the application, others struggled with the documents displayed on their screens. One participant using an iPad said that documents did not show properly: "If I have a PowerPoint, it doesn't

show me everything… if it's a pretty full page, it would cut off content at the bottom" (Participant 7). Another participant did not want to read using the application because the document displayed sideways, and every time they rotated the tablet, the document turned with it.

Additionally, one participant described incidents where the application crashed. Other negative statements referenced incompatibility of content, but it is unclear if the problem was related to the application or the methods by which instructors uploaded content.

> In my module 5, these are all videos, and I have to launch them as external tools. And then, I'll have one video that comes up totally fine. But these… I have to launch as separate individual tools. Sometimes this loads and sometimes it doesn't. (Participant 7)

Comparison

Most participants preferred the desktop version of Canvas to submit assignments, comment in forums, or edit long text. They said the bigger screen and full keyboard were ideal for performing these activities, as mobile devices were intended to type shorter text entries and were not practical for editing large documents. Additionally, some indicated that they have the materials they need saved on their computers, and it was more convenient to drag and drop files to the desktop interface. One participant reported the ease of work in the computer that allows her to easily extract information from multiple sources and incorporate them into the LMS.

However, they preferred the application when it comes to reviewing or checking information. In fact, some participants indicated that they never check their grades on the desktop version, and they appreciated the possibility of having the application always with them to check announcements and course content whenever possible. "I like the fact that, even when I

don't have my computer with me, I can have access to that stuff so I would say it's easier. More convenient*"* (Participant 6).

Research Findings

Quantitative Analysis Findings

Inferential Statistics

Based on the quantitative analysis, no statistically significant relationship exists between students' mobile self-efficacy and frequency of usage of the mobile LMS application. These findings were confirmed by regression analysis, which resulted in a p-value greater than 0.05. It was also found that no significant difference existed in the complexity of tasks for which students utilized the mobile application and mobile self-efficacy. These findings were demonstrated by additional regression analysis.

The relationships between mobile self-efficacy and several demographic characteristics were examined through ANOVA and MANOVA. These characteristics were gender, age, race, and preferred device. It was determined that none significantly impacted mobile self-efficacy, mobile application usage, or the interaction between these two variables. Therefore, when it came to statistical analyses, the null hypotheses were upheld for both H_1 and H_2.

Descriptive Statistics

Descriptive statistics were calculated for total scores on the mobile self-efficacy measure ($M = 54.83$, $SD = 3.49$). Scores were relatively consistent across the sample. The minimum score was 50, and the maximum score was 60 (the highest possible), resulting in a range of 10 points. Frequency of application usage ($M = 6.5$, $SD = 2.26$) suggests some variability in usage behavior across participants.

The item with the highest mean for the mobile self-efficacy measure was "I could use M-learning if someone assisted me in getting started" ($M = 9.67$, $SD = 0.52$). The item with the lowest mean was "I could use M-learning if I had never been exposed to a mobile LMS application before" ($M = 8.17$, $SD = 1.6$).

Overall, these descriptive statistics provide a more detailed understanding of participants' mobile self-efficacy and usage behavior, highlighting specific areas of strength and weakness in their perceptions and experiences with mobile LMS applications.

Table 3

Descriptive Statistics for Mobile Self-Efficacy Measure and Frequency of Usage

Item	Mean	Median	Standard Deviation	Min	Max	Range
I could use M-learning…						
…if there was no one around to tell me how it works.	9	9	0.89	8	10	2
…if I had never been exposed to a mobile LMS application before.	8.17	8	1.6	6	10	4
…if I had seen someone else experience it before I try it myself.	9.17	9.5	0.98	8	10	2
…if someone assisted me in getting started.	9.67	10	0.52	9	10	1
…if I had first gone through a lesson on how to use it.	9.33	10	1.03	9	10	2
…if I could refer to someone for help if I face difficulties.	8.17	8	1.6	6	10	4
Total Self-Efficacy*	54.83	55.5	3.49	50	60	10
Frequency	6.5	7	2.26	3	9	6

*Calculated field

Qualitative Analysis Findings

Uses of Canvas Mobile application

The interviews reiterated the survey results, particularly concerning RQ2 ("For what purposes are students utilizing the mobile application"). Participants were asked to demonstrate their use of the LMS Canvas application. The most common responses reflected uses of the application to "review" information (whether it was grades, course announcements, assignments) and read or watch course materials (lectures, videos, articles, etc.) Participant 3 indicated, "I typically use the Canvas mobile application for mainly checking my grade because it's an easy way for me to just be updated on my course." In fact, all participants mentioned the use of the application for grades.

Most participants did not use the application to submit assignments, post comments, or complete other activities that involve extensive editing or uploading documents to the platform. Some participants, like Participant 2, preferred a keyboard to type assignments. Others struggled with transitioning from source or reference material to the assignment submission area. In fact, most agreed that, if typing long texts, they almost always type beforehand and then uploaded through the application. Participant 2 stated, "I actually save the draft in my text messages … I was doing my project proposal, and it was really nice to be able to do this" (Participant 2).

Some participants indicated that the discussion forums work well in the application. However, one participant indicated serious problems with the interface when interacting in the discussion forum. "If you're talking about discussion boards, when you go to, like make a reply, it brings everything up so small, and it blocks the back," stated Participant 7. It is unclear whether those problems were related to the participant's settings in their mobile device, the instructor's settings for the course, or an issue in the application.

Participants liked having easy access to the mobile application and being able to stay logged-in. This was valuable for quick tasks that did not require many steps, as demonstrated by Participant 5, who stated, "I do like that it's easy to quickly access the app, and I'm already signed in, so I can see my courses right away."

Implications for HCI

Mobile applications are becoming increasingly widespread and offer significant advantages for learners, enabling them to conveniently access resources, engage in class discourse, and fulfill academic requirements from any location at any time. They offer a level of flexibility and convenience that traditional desktop-based interfaces may not provide. As such, flexibility should be a key consideration in designing and developing mobile LMS applications (Sarrab et al., 2018). This may involve ensuring the application is easy to navigate, employing clear instructions and guidance, simplifying the process of logging in, and providing learners the ability to personalize their own interfaces. These are all points that emerged from participants' statements in the study regarding their preferences and use of the mobile LMS application. Furthermore, with regard to interface design, the diverse needs of end-users should be addressed (Sarrab et al., 2018). The most common implications are for disabled learners, who may need support from screen-readers, appropriate contrast ratios between text and backgrounds, alt text, and the like.

While not directly addressed in participants' comments, it is also important to consider learner motivation and engagement with mobile LMS applications. To affect these, LMS applications should leverage captology by embedding tools to increase gamification, social learning, and personalized learning (Fogg et al., 2007). Examples of such tools include games for learning, augmented-reality and virtual-reality environments, badging, other gamification

elements or mechanisms, collaborative projects, discussion boards, and the like. It must be emphasized that, if any tools mentioned previously are utilized, they need to be optimized for a mobile device so that users do not face any frustrations when utilizing them in that environment.

Aside from the interface design, the application must have adequate support. This may include providing a quick and easy way to address problems, such as contacting a support team. It may also involve continually updating the application to maintain reliability and enhance security (Sarrab et al., 2018). The application may use a content repository of frequently asked questions that students may reference or integrate a chatbot for automated assistance, thereby reducing the need for human intervention. Similarly, the privacy and security of student data in the mobile application must be maintained (Sarrab et al., 2018). This may involve encryption, access controls, firewalls, and other tools as needed to comply with data protection laws and regulations.

Designing an effective mobile learning application involves many factors, and it is important to consider learners' different contexts and needs to optimize accordingly.

Conclusions and Recommendations

The goal of this study was to determine how students' mobile self-efficacy correlates with their usage of a mobile LMS application and the complexity of tasks completed. We also aimed to understand user's experiences with the application.

Based on the qualitative and quantitative analysis conducted in this study, it can be concluded that the mobile LMS application is, overall, well-received by college students. Participants noted that they appreciated the convenience of accessing course content when on the go and found the interface user-friendly. Additionally, the calendar feature was identified as being helpful with organization. However, some users expressed concerns about compatibility,

crashes, and limitations in screen size. It should be noted that these experiences were not common occurrences, but they do indicate potential areas of improvement for the application. Most participants indicated preferences for using the mobile application in reviewing and checking information. The desktop version was the preferred interface for more complex tasks such as submitting assignments and editing long text entries. This disparity in use was reported to be due to the user-friendly nature of computer peripherals such as mice and keyboards. Similar experiences were identified by Baldwin and Ching (2020) who indicate that device compatibility, content readability, format optimization, and mobile-friendly navigation are critical for interface design in m-learning applications. When creating mobile LMS applications, it is recommended that designers prioritize user-interface design, accessibility, support, motivation and engagement, and privacy and security. Furthermore, designers should ensure the mobile friendliness of content and ease of access to maximize student engagement and facilitate learning.

Regarding the research questions, the study found no statistically significant relationships between students' mobile self-efficacy and the frequency of mobile LMS application usage. These results are refuted by Shin and Kang (2015) who found that learners' mobile self-efficacy was positively correlated with the usage of mobile learning applications. Outside the domain of M-learning, similar conclusions were drawn regarding the use of other technologies and self-efficacy. As mentioned previously, Igbaria and Iivari (1995) found that higher levels of self-efficacy were tied to higher levels of computer usage. Furthermore, Stylianou and Jackson (2007) found that higher levels of self-efficacy were associated with higher e-commerce usage.

There were also no significant differences in the complexity of tasks for which students utilized the mobile application and mobile-self efficacy. Although there is no direct literature on the correlation between mobile self-efficacy and the complexity of tasks completed in

M-learning environments, research in other domains has identified correlations between self-efficacy and task complexity. For example, Wu et al. (2012) found significant differences in learners' vocabulary self-efficacy and completion of complex vocabulary tasks. Furthermore, as mentioned previously, Schwarzer (2014) indicates that the completion of more complex tasks is often tied to higher levels of self-efficacy. Lastly, Bandura (1982) argued that greater effort given to completing a task was often indicative of higher levels of self-efficacy.

Demographic characteristics such as gender, age, race, and preferred device were also reviewed to see if these groups had significant differences concerning mobile self-efficacy and usage behavior. No statistical differences were determined in this sample. Similar conclusions were drawn by Yorganci (2017) who leveraged a similar self-efficacy instrument and found no significant differences among genders.

While the instruments and interviews used in the study provided valuable insights, it is recommended that future researchers employ a larger and more representative sample as this pilot only consisted of seven participants. Making this change would help ensure future findings are more generalizable to a wider population of higher-education students. Additionally, it should be noted that M-learning adoption can be impacted by a number of factors, not only self-efficacy. Therefore, it is recommended that future studies also investigate factors such as prior experience, network availability, perception of M-learning, and similar variables to see how these impact adoption.

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Appendix A

Consent to Participate in a Research Study

Project Title: Students' Self-Efficacy with Mobile Technology and Usage of the Learning Management System (LMS) Mobile Application
Principal Investigator/Researchers: Heather Boyd, Wilson Castaño, Alicia Long
IRB Reference Number: 2096196

You are being invited to take part in a research project. You must be 18 years of age or older. Your participation is voluntary, and you may stop being in this study at any time. The purpose of this research project is to understand how mobile self-efficacy correlates with the usage of a mobile Learning Management System (LMS) application. You are being asked to complete a survey regarding your confidence with mobile learning applications and usage of your institution's mobile LMS application and engage with researchers via a virtual interview. The interview will be scheduled at your convenience and will last approximately 30 minutes. The survey can be completed on your own time and should not take longer than 30 minutes to complete. No personal information will be disclosed and your answers will be analyzed without any identifiable information.

If you have questions about this study, you can contact the University of Missouri researchers at heather.boyd@mail.missouri.edu, alicia.k.long@mail.missouri.edu, or wilson.castano@mail.missouri.edu or contact Dr. Joi Moore (moorejoi@missouri.edu), faculty advisor. If you have questions about your rights as a research participant, please contact the University of Missouri Institutional Review Board (IRB) at 573-882-3181 or muresearchirb@missouri.edu. The IRB is a group of people who review research studies to make sure the rights and welfare of participants are protected. If you want to talk privately about any concerns or issues related to your participation, you may contact the Research Participant Advocacy at 888-280-5002 (a free call) or email muresearchrpa@missouri.edu.

You can ask the researcher to provide you with a copy of this consent for your records, or you can save a copy of this consent if it has already been provided to you. We appreciate your consideration to participate in this study.

Appendix B

Mobile Self-Efficacy Measure

For each of the items listed below, please answer if you think you would be able to use the mobile LMS application (M-learning) for that specific condition. Circle either "yes" or "no." For the questions where you circled "yes," rate your confidence in that judgment on a scale of 1-10, with 1 meaning "Not at all confident," 5 meaning "Moderately confident," and 10 meaning "Totally confident."

Refer to the sample item below:

I could use M-learning…		Not at all Confident				Moderately Confident					Totally Confident
…if there was no one around to tell me how it works.	(Yes) No	1	2	3	4	(5)	6	7	8	9	10

The sample response indicated that the person believed they could finish the task using software with guidance (Yes was selected) and had a fair level of confidence in their ability to do so (a 5 was chosen).

Complete the items below based on the instructions.

	I could use M-learning…			Not at all Confident									Totally Confident
Q1	…if there was no one around to tell me how it works.	Yes	No	1	2	3	4	5	6	7	8	9	10
Q2	…if I had never been exposed to a mobile LMS application before.	Yes	No	1	2	3	4	5	6	7	8	9	10
Q3	…if I had seen someone else experience it before I try it myself.	Yes	No	1	2	3	4	5	6	7	8	9	10
Q4	…if someone assisted me in getting started.	Yes	No	1	2	3	4	5	6	7	8	9	10
Q5	…if I had first gone through a lesson on how to use it.	Yes	No	1	2	3	4	5	6	7	8	9	10
Q6	…if I could refer to someone for help if I face difficulties	Yes	No	1	2	3	4	5	6	7	8	9	10

Appendix C

Mobile Application Usage Survey Instrument

DEMOGRAPHIC INFORMATION

Which of the following best describes your gender?

- Male
- Female
- Nonbinary
- Prefer to self-describe _____

Which of the following best describes your age?

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 or over

Which of the following best describes you? Select all that apply.

- Asian or Pacific Islander
- Black or African American
- Hispanic or Latino/x/e
- Native American or Alaskan Native
- White or Caucasian
- Multiracial or Biracial
- A race or ethnicity not listed here

FREQUENCY

In the question below, circle the number that best corresponds with your usage of the mobile LMS application.

	Rarely				Sometimes					Frequently
How frequently do you utilize the mobile LMS application?	1	2	3	4	5	6	7	8	9	10

DEVICE

On what type of device do you *typically* access the mobile LMS application? Select all that apply.

- iPhone
- Android Phone
- iPad
- Android Tablet

If you selected more than one device in the previous question, what type of device do you *prefer* when accessing the mobile LMS application?

- iPhone
- Android Phone
- iPad
- Android Tablet

USAGE BEHAVIOR

Please use a checkmark to indicate which application you *typically* use to complete each of the tasks below.

Task	Mobile LMS Application	Website
Reviewing or reading module's content or lessons	☐	☐
Reviewing feedback	☐	☐
Accessing grades	☐	☐
Emailing peers and/or instructors	☐	☐
Submitting assignments previously created	☐	☐
Participating in discussion boards	☐	☐
Completing a quiz or assessment	☐	☐
Creating and submitting written assignments (i.e. essays, presentation slides, written calculations, etc.)	☐	☐

Please use a checkmark to indicate which application you *prefer* to use to complete each of the tasks below.

Task	Mobile LMS Application	Website
Reviewing or reading module's content or lessons	☐	☐
Reviewing feedback	☐	☐
Accessing grades	☐	☐
Emailing peers and/or instructors	☐	☐
Submitting assignments previously created	☐	☐
Participating in discussion boards	☐	☐

Accessing grades	☐	☐
Creating and submitting written assignments (i.e. essays, presentation slides, written calculations, etc.)	☐	☐

Please explain any discrepancies between what you typically use and what you prefer. For example, if you typically use the Web Application for a task but prefer the Mobile LMS Application, why do you typically use the application you do not prefer?

Please explain why you prefer either the mobile LMS application or the web application for each task.

Appendix D

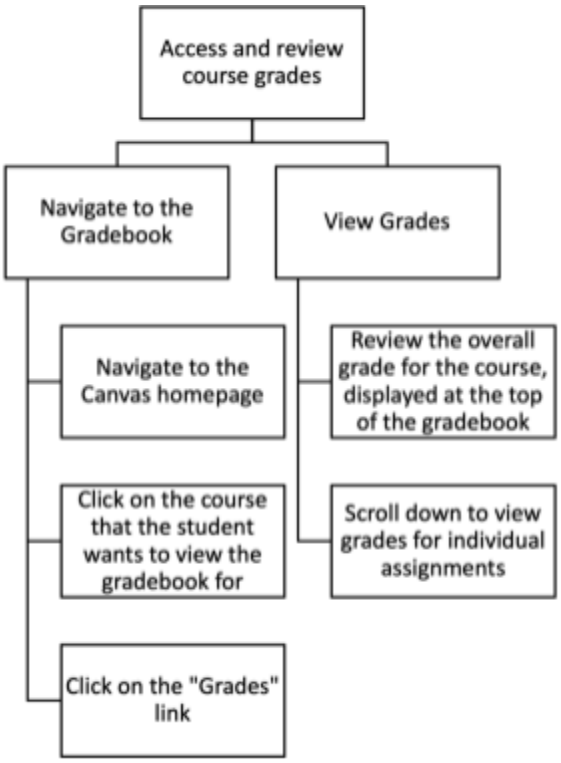
Interview Questions

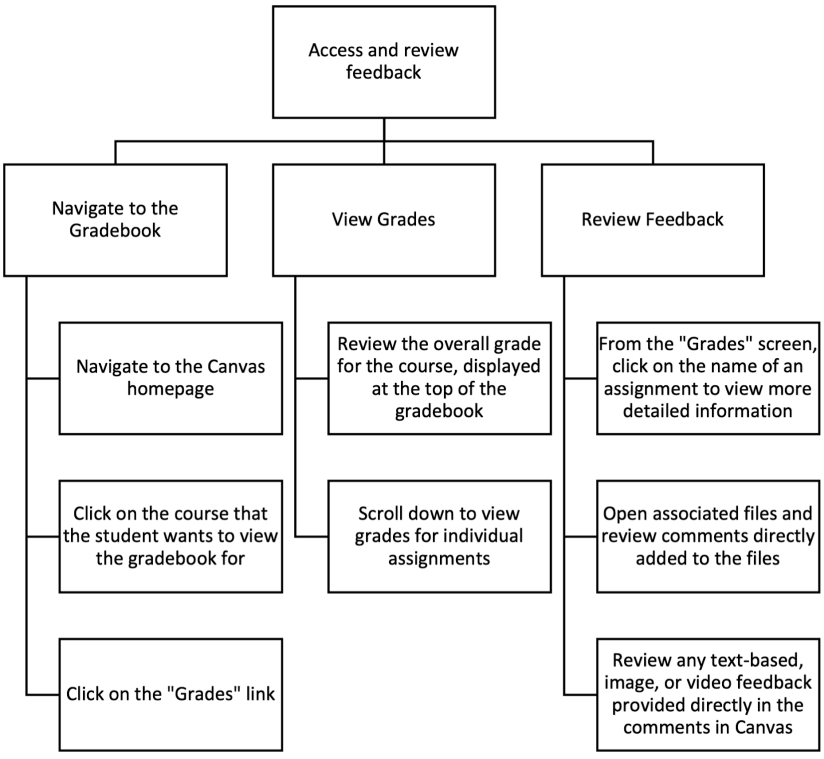
1. Can you please explain the tasks for which you use the Canvas Student app?
2. Can you show us how you typically complete these tasks on the app?
3. Can you please explain what you like about the app?
4. Can you please explain what you do not like about the app?
5. How would you compare the application to the web-based version of Canvas?
    a. What do you prefer about the web-based version?
    b. What do you prefer about the app?
6. Are there any other things you would like to share about using the Canvas Student app?

Appendix E

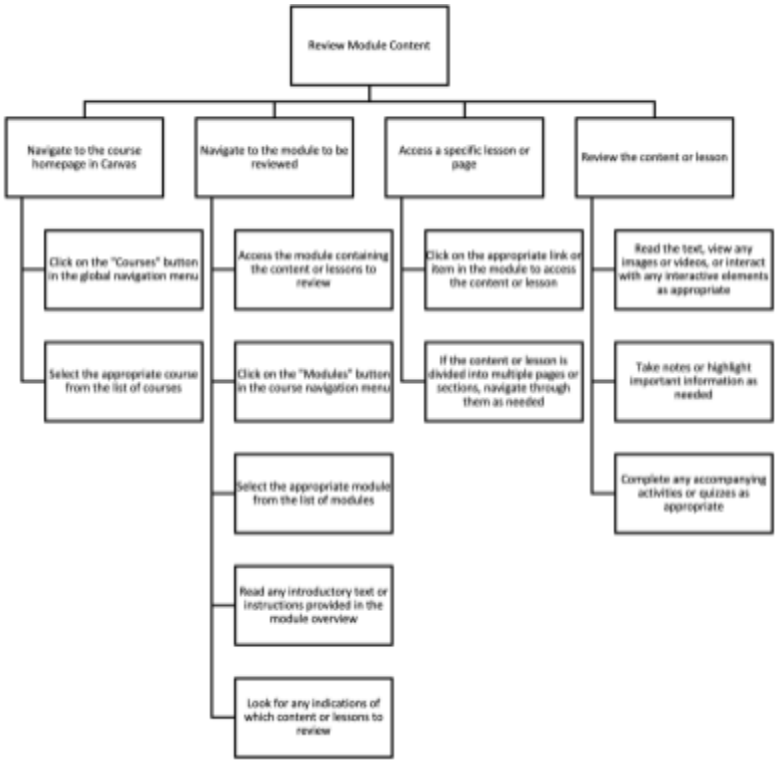
Hierarchical Task Analyses

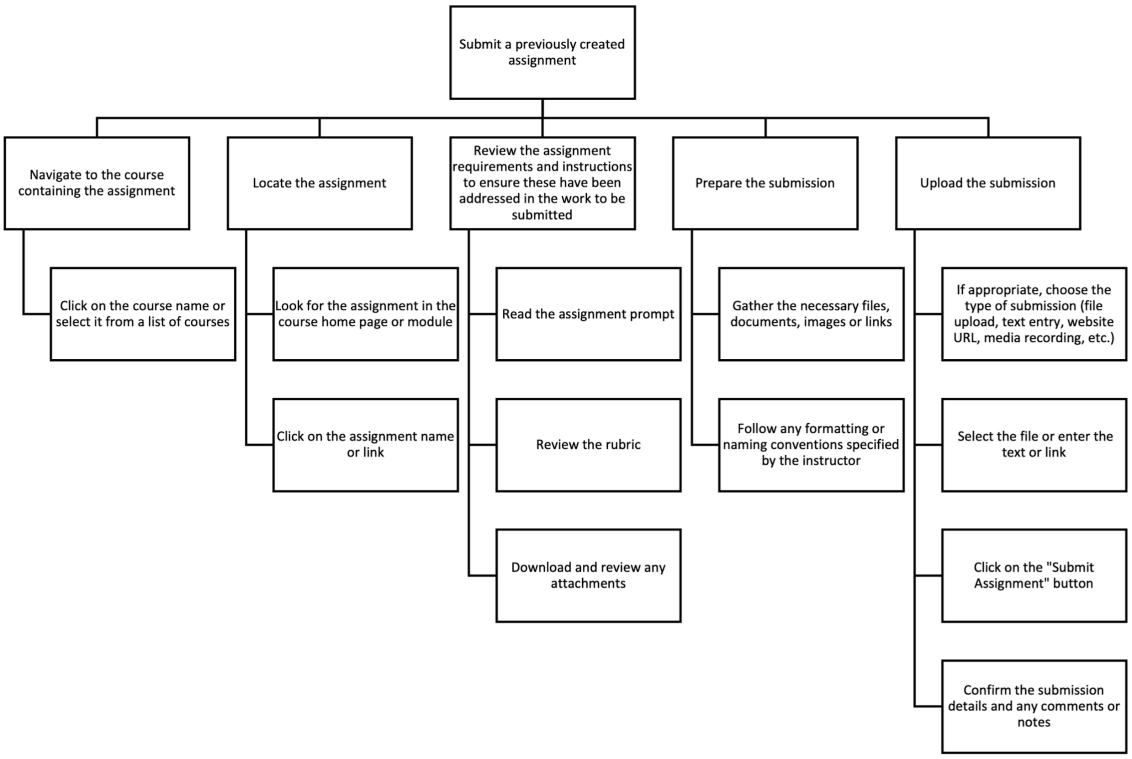
Low Complexity

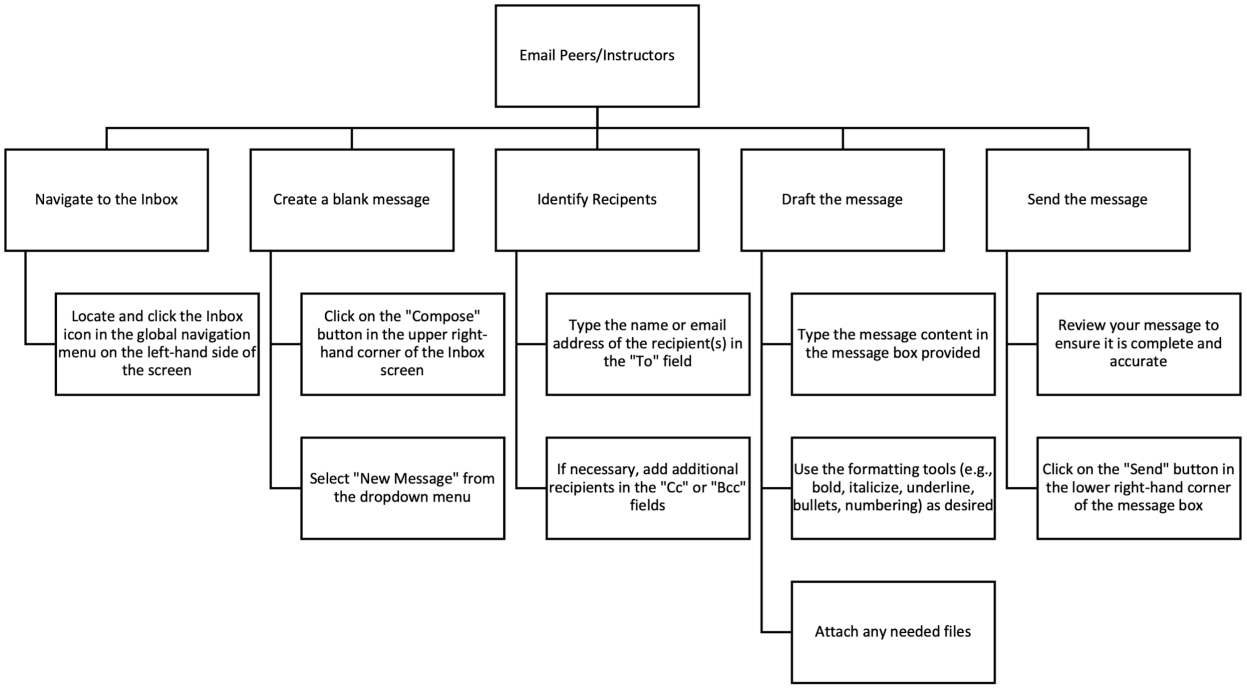




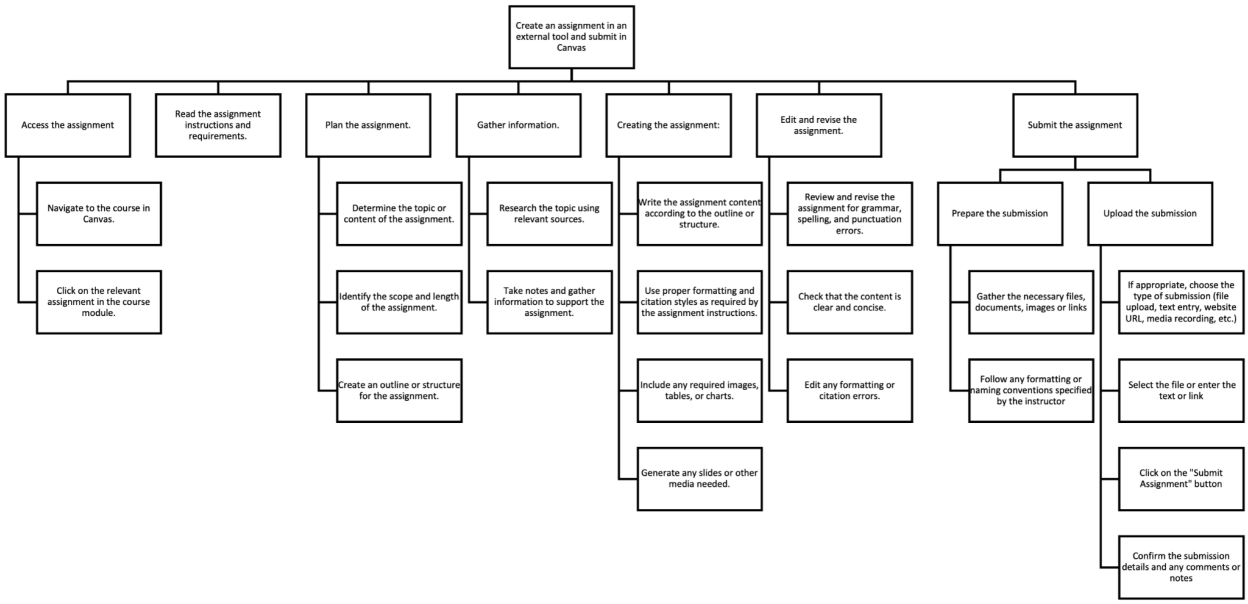
Moderate Complexity

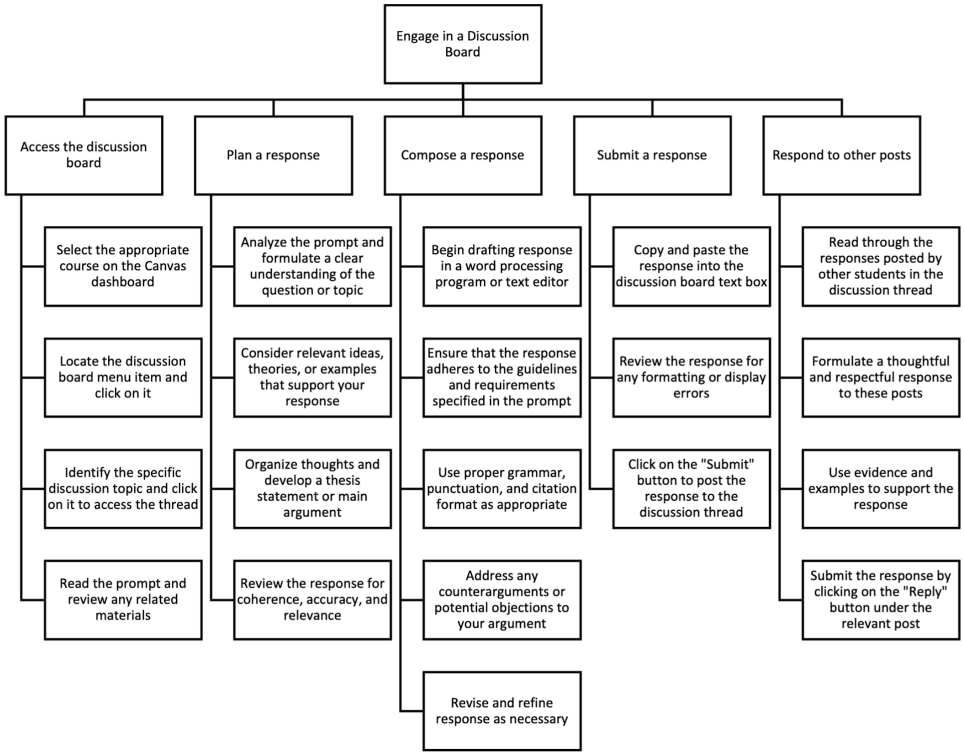


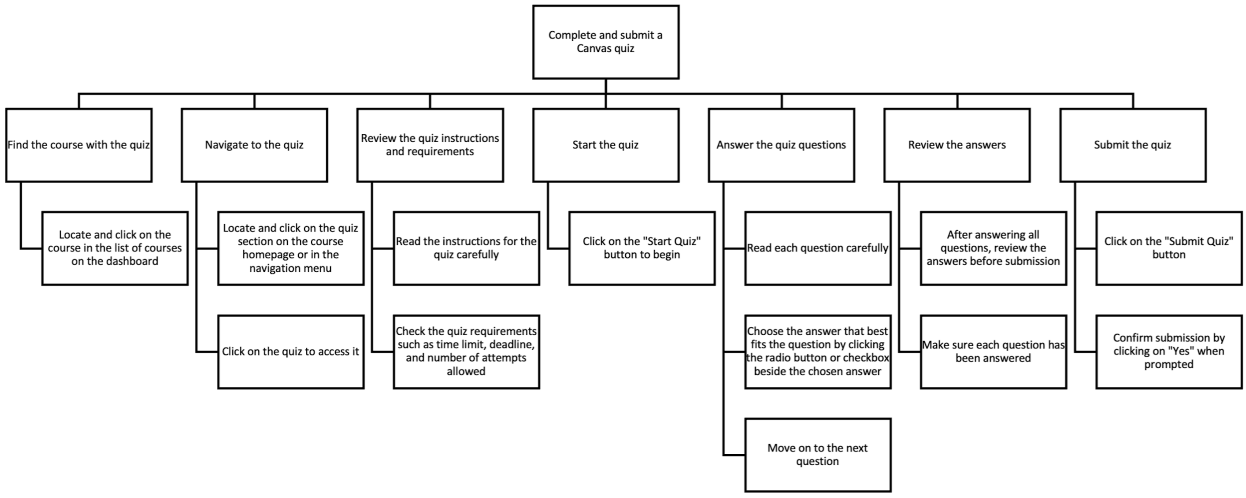




High Complexity




Engage in a Discussion Board
Access the discussion board
Plan a response
Compose a response
Submit a response
Respond to other posts
Select the appropriate course on the Canvas dashboard
Locate the discussion board menu item and click on it
Identify the specific discussion topic and click on it to access the thread
Read the prompt and review any related materials
Analyze the prompt and formulate a clear understanding of the question or topic
Consider relevant ideas, theories, or examples that support your response
Organize thoughts and develop a thesis statement or main argument
Review the response for coherence, accuracy, and relevance
Begin drafting response in a word processing program or text editor
Ensure that the response adheres to the guidelines and requirements specified in the prompt
Use proper grammar, punctuation, and citation format as appropriate
Address any counterarguments or potential objections to your argument
Revise and refine response as necessary
Copy and paste the response into the discussion board text box
Review the response for any formatting or display errors
Click on the "Submit" button to post the response to the discussion thread
Read through the responses posted by other students in the discussion thread
Formulate a thoughtful and respectful response to these posts
Use evidence and examples to support the response
Submit the response by clicking on the "Reply" button under the relevant post


Complete and submit a Canvas quiz
Find the course with the quiz
Navigate to the quiz
Review the quiz instructions and requirements
Start the quiz
Answer the quiz questions
Review the answers
Submit the quiz
Locate and click on the course in the list of courses on the dashboard
Locate and click on the quiz section on the course homepage or in the navigation menu
Click on the quiz to access it
Read the instructions for the quiz carefully
Check the quiz requirements such as time limit, deadline, and number of attempts allowed
Click on the "Start Quiz" button to begin
Read each question carefully
Choose the answer that best fits the question by clicking the radio button or checkbox beside the chosen answer
Move on to the next question
After answering all questions, review the answers before submission
Make sure each question has been answered
Click on the "Submit Quiz" button
Confirm submission by clicking on "Yes" when prompted

Appendix F

Codebook for Qualitative Analysis

Types of tasks:

- Reviewing content:
    - Review announcements
    - Review materials
    - Review assignments
- Review feedback
- Grades
- Emailing
- Submitting
- Quizzes
- Discussions
- Create content

Type of experience:

- Positive Ux
- Negative Ux

Other characteristics:

- Navigation
- Esthetics-visuals
- Compatibility
- Convenience
- Already logged in
- Organization
- Accessibility

Other themes/features:

- Perception
- Calendar
- Improvements
- Laptop
- Multitasking
- Typing