

The Pennsylvania State University
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**UNDERSTANDING NON-PARTICIPATION IN A SELF-REGULATED
COMPUTER-MEDIATED COMMUNICATION IMPLEMENTATION:
EXPLORING CHALLENGES AND IMPLICATIONS**

A Dissertation in
Informatics
by
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Abstract

The COVID-19 pandemic and the subsequent shift to online and hybrid learning brought to the forefront several long-standing issues within the educational domain, including engagement, collaboration, and motivation. During this period, many faculty members and students struggled to find viable solutions to these challenges. Previous studies have explored the use of Computer-Mediated Communication (CMC) to address these issues. In our study, we sought to develop a self-regulated CMC approach that would empower students to take charge of their own learning, engagement, motivation, and peer interaction.

To do so, we created a self-regulated implementation to CMC using Slack. The implementation was introduced across four different courses at Pennsylvania State University. These were three undergraduate and one graduate-level course. Each course had its own Slack workspace with four separate channels, each created with its own purpose in mind, from asking questions to assignments and for general conversation. However, despite our initial assumptions, we discovered that adopting these channels fell short of our expectations as volunteers recruited from these courses did not use them beyond a few superficial interactions.

To understand why our initial approach failed and to improve future iterations of self-regulated CMC, we conducted twelve 45-minute interviews with students from these four courses. The interviews helped us identify the main challenges that hindered the adoption of our approach, as well as the perceived motivational benefits. Based on these findings, we propose a gamified framework to increase engagement and adoption of self-regulated CMC in future implementations. Additionally, we suggest using emergent technologies for management and moderation to further enhance the efficacy of these approaches.

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Chapter 1 |

Introduction

Over the years, the education sector has undergone significant transformations by integrating new technologies and methodologies [Yordanova, 2007, Fayolle et al., 2006]. These changes have provided new opportunities that were otherwise impossible and have improved the learning and teaching experience for both students and teachers [Leidner and Jarvenpaa, 1995]. Modern technologies changed the educational paradigm and became the norm for many colleges and universities all over the country [Fabry and Higgs, 1997, Herold, 2016]. However, some challenges still exist and remain unsolved. Traditional educational methods have focused on information transfer from instructor to student, which lacks consistency in promoting collaboration and student engagement [TRENtIn, 2009]. Modern technologies have addressed some of these challenges, but they have also introduced new ones, such as the need for the adoption and engagement of these technologies by students and faculty. Therefore, it is essential to develop frameworks that address these challenges and effectively provide solutions for implementing new technologies and methodologies in education.

The COVID-19 pandemic exposed some of these challenges in the educational field, particularly in the areas of engagement and motivation [Tsai et al., 2020]. With the abrupt shift to online classes, students and instructors faced difficulties communicating with each other and maintaining normal levels of engagement and motivation. The lack of in-person interaction made it harder for students to find motivation to do their work, while faculty struggled to keep their students engaged meaningfully. However, the

pandemic also brought some benefits, such as increased flexibility. During this period, faculty and students could adjust their schedules and work according to their liking. But even this proved to be a double-edged sword, as students faced challenges maintaining a routine that worked for them. Overall, the pandemic highlighted the need for innovative approaches to education that can address the challenges of engagement and motivation while also providing flexibility and support for students and faculty.

The pandemic was a new experience for many, but it highlighted familiar issues within education, such as engagement, motivation, collaboration, and collaborative learning [Saeed and Zyngier, 2012]. Despite extensive research, using modern technologies to increase engagement and motivation remains contentious in academia due to barriers such as technology adoption [Scherer et al., 2019] and the scalability of interventions and tools [Niederhauser et al., 2018]. For technology adoption new technologies have struggled to find their place because of the difficulties found in their adoption because of how difficult it is to implement those in a real classroom. For scalability, the issue is that some of these technologies and implementations tend to be tested and studied within the confines of relatively small classrooms. While these environments provide a test bed to investigate different interventions, tools, and technologies, they can fail to understand how these scale into bigger classrooms. This is linked to another issue that sometimes gets unappreciated: the time and work needed to manage some of these technologies and approaches. Finally, it is worth noting that the beliefs and attitudes of teachers towards modern pedagogical approaches can pose a significant challenge that cannot be easily overcome by technology alone [Ertmer, 2005]. This poses a challenge insofar as instructors do not believe in the promise of the pedagogical benefits of any integrated tool there is a risk of failed integration [Kim et al., 2013].

Any tool or technology introduced within the educational domain should consider the abovementioned issues. Our study aimed to minimize issues such as adoption by resorting to well-documented solutions in the literature. Our first approach was to use existing infrastructure to support the study [Dourish et al., 2010, Carroll et al., 2021]. We chose a tool already widely adopted and well-used in education and industry, namely Slack. Our

initial assumption was that this platform would meet most of the needs required by the students and professors alike [Papathoma, 2022]. Furthermore, we believed that having such a platform, which was already known in both the professional and academic worlds, would reduce the effort required for its adoption and use by students. However, as we discovered through our study, we faced both technological and educational challenges, indicating that our initial assumptions were incorrect.

After encountering the challenges and realizing the need for a better understanding, we conducted an in-depth study to examine how modern technologies and tools may have impacted our approach and experiment to self-regulated Computer-Mediated Communication (CMC). Through a comprehensive interview process, we sought to address various issues, including technological challenges related to adoption, accessibility, and the prevalence of other tools in students' daily lives, as well as common educational challenges such as integration, involvement, and engagement. Our interviews revealed that despite our efforts to minimize these challenges by providing students with a widely accepted tool and utilizing different courses to implement our approach, technology adoption and engagement remained critical obstacles in a self-regulated learning environment.

Based on our findings, students' recommendations and a review of modern literature, we suggest a design framework to address the issues of adoption and engagement we identified during our interviews. Our framework proposes using learning management systems (LMS) to address the adoption issues we found. We also propose a gamified approach, viewed through the lens of liminal spaces, to engage students and help them become more comfortable with the introduction of a real-time chat within the context of their LMS platforms. Additionally, to address potential technological barriers, we suggest using conversational AIs to assist with self-regulated CMC and minimize the impact on faculty workload. Our proposed design framework aims to leverage gamification's distinct qualities and benefits to promote adoption and engagement while providing a tailored approach to meet the specific needs of students found throughout our interviews. By incorporating elements such as onboarding, exploration, personalization, and incentivized activities, we look to promote familiarity and comfort with the LMS chat and foster a sense

of community and competition among students. Overall, we believe that our proposed design framework provides a comprehensive solution to the challenges of adoption and engagement in self-regulated CMC. We acknowledge that additional research is needed to evaluate the effectiveness of our approach and its potential impact on learning outcomes.

1.1 Problem Statement and Dissertation Overview

In traditional educational methodologies, the instructor has been the voice of authority in all matters about their course. This has relegated students to almost feel like spectators in which their voices do not have much power or their voices are not heard enough. Moreover, these approaches have left little room for students' collaboration, motivation, and engagement, which are proven to be necessary to improve learning. However, using other approaches to engage and motivate students has often increased faculty's workload [Saleem et al., 2022]. Our motivation erupted from the lack of CMC approaches in which the implementation is self-regulated by students without incurring more work for the faculty members.

Drawing from previous research, we were aware of the potential for students to form their own CMC communities within their courses and departments [Tinto and Goodsell, 1994, Goodman, 2020]. However, the occurrence of these communities varies and is difficult to predict. In an effort to provide a more structured approach, we introduced a self-regulated CMC method where faculty could create the CMC space and allow students to manage their own interaction. Unfortunately, some of our assumptions did not align with reality, prompting us to conduct a study to better understand the shortcomings and challenges of our implementation and identify strategies to improve future iterations.

Therefore, our current research aims to investigate the reasons why our approach to self-regulated CMC did not meet our expectations and identify potential solutions based on modern research.

1.2 Research Questions

The pandemic showed a need for a new educational approach to engagement and motivation. Technology is more prevalent now than ever, and it has shown that, to a degree, this technology allowed everyone to maintain a certain sense of normalcy during exceptional times. To an extent, the pandemic showed that education can be carried through CMC thanks to tools and software such as Zoom, Webex, and Microsoft Teams. However, the richness of this medium, different approaches to these tools, and issues such as flexibility and camera use [Tsai et al., 2020] eroded student engagement and motivation, leaving very few solutions from the instructor side. However, as scholars try to solve those issues of engagement and motivation, faculty members often see themselves having to put in additional work and effort that they might not always have. Hence our goal was to create an approach that could see CMC implemented in a way that did not invoke more work, managerial or else, to CMC. To do this, we ran an experiment of self-regulated CMC in which we left students to manage and moderate their own interaction through the channel we created.

However, because our experiment fell short of expectations and our assumptions were tested wrong, we embarked on a project to learn our experiment's challenges. The study provided us with a rich environment to understand, from many different perspectives, the challenges that our experiment faced by asking directly students who took part in the study. Based on this, our research had two goals: 1) Understand and examine the challenges that hinder self-regulated CMC and 2) How these can inform the design of new tools and approaches for future use and application. Hence our research questions are:

1. *How do modern technologies, tools and educational challenges affect students' approach to self-regulated CMC?*
2. *How can the study of these challenges inform the design of new tools for self-regulated CMC?*

Chapter 2 |

Literature Review

2.1 Technology Adoption

One of the central tenets in technology adoption is the Technology Acceptance Model (TAM) [Davis, 1985]. First introduced in 1986 by Fred D. Davis the TAM model is currently one of the most widely applied theoretical frameworks. The TAM model makes two assumptions about why a particular technology is accepted. These assumptions are the *perceived usefulness* and the *perceived ease of use*. These two assumptions are based on the notion that individuals first use an application with the belief that its use will help them achieve their desired goals or job, that is its perceived usefulness. The second, is that the user needs to feel whether its benefits out-weights the effort of using the tool [Davis, 1989]. According to Davis, these two assumptions are based on underlying theories, these being *Self-Efficacy Theory* and *Cost-Benefit paradigm*.

2.1.1 Self-Efficacy Theory

Studied and proposed by Bandura [Bandura, 1982], the self-efficacy theory's main argument is a person's idea, or "judgment on how well they can execute courses of actions that are required to deal with the prospective situation". In other words, self-efficacy theory explains how well we think we will perform a task based on the course of action, we need to take to solve or deal with the situation. It is why those self-efficacy judgments

are paramount in terms of individuals' actions. As explained by Bandura, individuals will avoid any activity they believe they cannot cope with. However, they will go ahead with any activity they deem themselves capable of doing. Interestingly, this occurs despite whether the person is actually capable of completing the activity or not. This is especially important because it also guides how much effort and time people will put into these activities. Hence we can see that higher levels of self-efficacy will provide individuals with enough dedication and effort required to master or optimize performance. However, how does this self-efficacy theory apply in the domain of learning and education?

There are many instances in which the self-efficacy theory has been investigated within the domain of education and learning [Van Dinther et al., 2011, Barkley, 2006]. This theory shows that students with a higher sense of self-efficacy tend to put more effort and spend more time with a task [Schunk, 1982]. In contrast, those individuals with self-doubts and a low sense of self-efficacy will avoid any tasks given to them. Self-efficacy beliefs are generally raised and lowered through successes or failures; hence in a classroom environment, students can learn not only about their self-efficacy but about others. One way to help students gain more knowledge about their self-efficacy beliefs and increase is through performance feedback, rewards, and social comparison. Prior studies have shown this to be an effective method. For example, Jackson [Jackson, 2002] explored the effect of self-efficacy in the classroom environment by using a 7-point questionnaire where he recorded the self-efficacy scores of each student and, based on random selection, sent a positive or a neutral note (email to their students). The note would act as a reward or performance feedback for the students. This study proved that self-efficacy beliefs were linked to learning performance. It also argued that students communicating with each other could raise or lower the self-efficacy of some, which would be in line with previous studies [Bandura and Schunk, 1981]. In addition, self-efficacy has been said to be highly correlated to self-regulation [Schunk, 1996], as self-efficacy develops through effective strategies and effective mechanisms. Students can gather cues that tell them if what they are doing works. In other words, self-efficacy within the learning domain helps maintain motivation and teaches students self-regulatory practices.

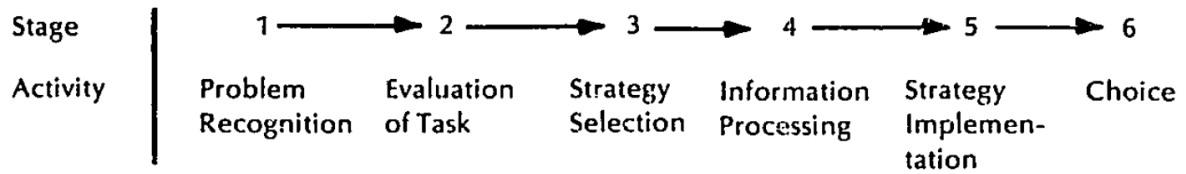


Figure 2.1. Decision Making Model

2.1.2 Cost Benefit Paradigm

The cost-benefit paradigm emerges from the behavioral decision theories [Beach and Mitchell, 1978, Johnson and Payne, 1985]. The first model, created by Beach and Mitchell investigates and hypothesizes the decision strategies used by people in different scenarios. Their model is built upon the assumption that every decision-making process follows a linear pattern (as seen in Figure 2.1), and that individuals will pursue the strategy that gives the best results with the least amount of effort. However, their conclusion is that strategy selection boils down to the cost/benefit of a given scenario, and the strategy selection is contingent on that particular situation. Moreover, environmental constraints such as money and time can, and do reduce the number of strategies that can be available at any given time. The second approach to the cost-benefit paradigm by Johnson and Payne takes a different approach to that of Beach. In this approach, decision and choice are based on two primary points. These are the ability to "produce an accurate response" and the effort that needs to be put into that choice. This comes to be the cost-benefit model, which implies that there is always a trade-off between someone's accuracy and effort. Similar to Beach's proposition, this cost-benefit model is also contingent on the context of the task or choice. Hence, based on the Cost Benefit paradigm, we believe that providing students with an already set-up tool and approach to CMC could nudge students away from the best results versus the least effort trade-off. Additionally, any new tool introduced for CMC purposes must have this same trade-off in mind, or it risks failing at its adoption.

Keeping these two theories in mind, we can argue that the adoption of a specific technology boils down to how easy to use it is and what are the costs. Moreover, the

Table 1. Initial Scale Items for Perceived Usefulness

1. My job would be difficult to perform without electronic mail.
2. Using electronic mail gives me greater control over my work.
3. Using electronic mail improves my job performance.
4. The electronic mail system addresses my job-related needs.
5. Using electronic mail saves me time.
6. Electronic mail enables me to accomplish tasks more quickly.
7. Electronic mail supports critical aspects of my job.
8. Using electronic mail allows me to accomplish more work than would otherwise be possible.
9. Using electronic mail reduces the time I spend on unproductive activities.
10. Using electronic mail enhances my effectiveness on the job.
11. Using electronic mail improves the quality of the work I do.
12. Using electronic mail increases my productivity.
13. Using electronic mail makes it easier to do my job.
14. Overall, I find the electronic mail system useful in my job.

Figure 2.2. Perceived Usefulness

trade-off between the benefit must out-weight the effort it takes to use such technology. A great example is Figure 2.2 by Davis. Take as an example the e-mail, which we know its usefulness, that it creates affordances for the users, something that otherwise, without the tool, would be impossible to achieve. Because the TAM model has been studied and tested many times, it has found its way into many disciplines as an attempt to explain the roadblocks to technology adoption. Our goal here yields in adopting technology within the domain of education and for learning purposes. Hence, framing the TAM model in the educational domain can help us understand its use more.

2.1.3 TAM in Education

The TAM model has been widely adopted and applied in the field of education. In fact, it has been widely used in the domain of e-learning [Granić and Marangunić, 2019]. In this domain, two prominent figures are Park et al. and Farahat, both of which tested the original TAM model within the educational context. Park et al. [Park et al., 2007] tested and revealed that within the educational domain, perceived ease of use was one of the major points when adopting a new system. An essential addition to their study was the gratification approach for TAM, concluding that motivation plays a big

role in technology adoption. Their study showed that adding motivational aspects to the construct of the TAM increased the perceived ease of use and perceived usefulness. Similarly, Farahat [Farahat, 2012] also applied the TAM model in the educational context, and its results and conclusions aligned with those of Park et al. However, a difference from Park's study is that Farahat found that initial attitudes and the influence of peers around students impacted the acceptance of new technology. Farahat introduced a new layer of complexity and thought by suggesting that social influence, perceived ease of use, usefulness, attitude, and *Behavioral Intention of Use* all impacted the adoption of a new system. Coupled with the findings by Park, this would suggest that motivating students as a group would increase the social influence and the attitude of those towards the new system.

These, however, are not the only examples in which the TAM model has been applied in educational contexts. Studies in Library and Information Science [Adetimirin, 2015], examined students' acceptance of Online Discussion Forum (ODF) in the context of e-learning. Among their findings, the study noted that computer playfulness influenced the use and adoption of these ODFs. The study also pointed out that computer self-efficacy and perceptions of external control also correlated with the adoption of ODF in the context of e-learning. Other studies [Sánchez and Hueros, 2010] also examined the ingrained motivational factors that influence the acceptance of a new system by using the TAM model. In contrast with other studies, the study conducted by Sanchez & Hueros found that perceived ease of use and perceived usefulness were directly influenced by providing technical support. This would suggest that adding external support to that new system or technology can greatly help its adoption. Besides these studies, research has tried to integrate the TAM model with Flow theory and Media richness theory to explain user acceptance of streaming media for e-learning. But Liu et al. [Liu et al., 2009] suggested in their study that the TAM model cannot explain the acceptance of new technology or system.

The pandemic focused much of the attention on the methodologies and technologies that have been used in different classroom environments. Hence, many researchers

started examining how students accept or use the different technologies and how their use impacted them. One example of this is the study by Aguilera-Hermida [Aguilera-Hermida, 2020] in which their study found that technology and motivation played a significant role in the cognitive engagement and academic performance of the students. Other studies [Famularsih, 2020] also emphasized the importance of learning applications while identifying some of the issues of adopting new learning technologies, such as the lack of interaction between students and instructors. The literature provides us with a good base to understand how students and faculty go on accepting a new technology or system for learning purposes. However, literature is rather scarce in proving qualitative evidence for the TAM model in the field of education. Among the different goals of this study, it also aims to get a qualitative understanding of how we can understand the challenges these systems suffer when being adopted in educational environments.

2.2 Engagement & Motivation

Student engagement has often been touted as a key factor for learning and has been studied extensively. Nevertheless, what do engagement and motivation mean in the context of education? Previous attempts to define are varied, but the description that fits better to our study is the one by Axelson and Flick [Axelson and Flick, 2010] in which they define student engagement such as "*The byproduct of a learning environment that suits the student*". Using this definition of engagement, we can argue that there are two major points made. The first one is the assumption that engagement emerges directly out of the learning environment. Engagement is created or born because the environment is appropriate. Second, using this definition of engagement, we can further argue that engagement levels would change if we were to change the environment in which students or instructors are. However, the literature suggests there is not only engagement happening at any given time, but students must also feel *integration* and *involvement* within their environments for engagement to emerge [Wolf-Wendel et al., 2009].

2.2.1 Integration & Involvement

Integration is generally brought up to explain how students share their attitudes and beliefs with others. Later re-framed by Tinto [Tinto, 1987] to explain students' interactions with their peers, faculty, and staff at their institutions. In Tinto's theory of academic and social integration, this integration meant the difference between dropping off or staying at a college. Tinto argued that students' social and academic integration could be used to predict their departure. Tinto's integration theory would become a cornerstone in which further studies and more literature would be created. Among these works, the one done by Pascarella & Terenzini [Pascarella and Terenzini, 1980] focused on integration as they deemed it the most crucial aspect of engagement. Their proposition was that focusing specifically on the *Institutional Experiences*, (Figure 2.3) would help the social and academic integration and hence help the student in its decision to stay or leave the institution. However, further research [Chickering and Gamson, 1987] proposed that using the correct integration techniques had a positive impact on students' learning, none being more important than the other but reciprocal as a whole.

We can use the definition proposed by Astin [Astin, 1984] to define involvement. Astin's definition argues that involvement is the amount of psychological and physical effort the student is willing to put into the academic experience. According to this definition, Astin proposed that a student with a high degree of involvement would fare better than those with a low degree of involvement. His theory of involvement revolved around five basic tenets that characterized the properties of this involvement. Among these, two are especially important to consider. First, involvement is regarded as something that occurs along a continuum; that is, involvement can change at any time and to various degrees. The second is that how involvement can be measured is quantitative (for example, the hours of work put into an exam) or qualitative (whether students understand a text or a lesson). These two tenets are important because Astin's theory of involvement emphasizes the student-faculty relationship more and encourages instructors and teachers to focus more on what the students do than themselves. His

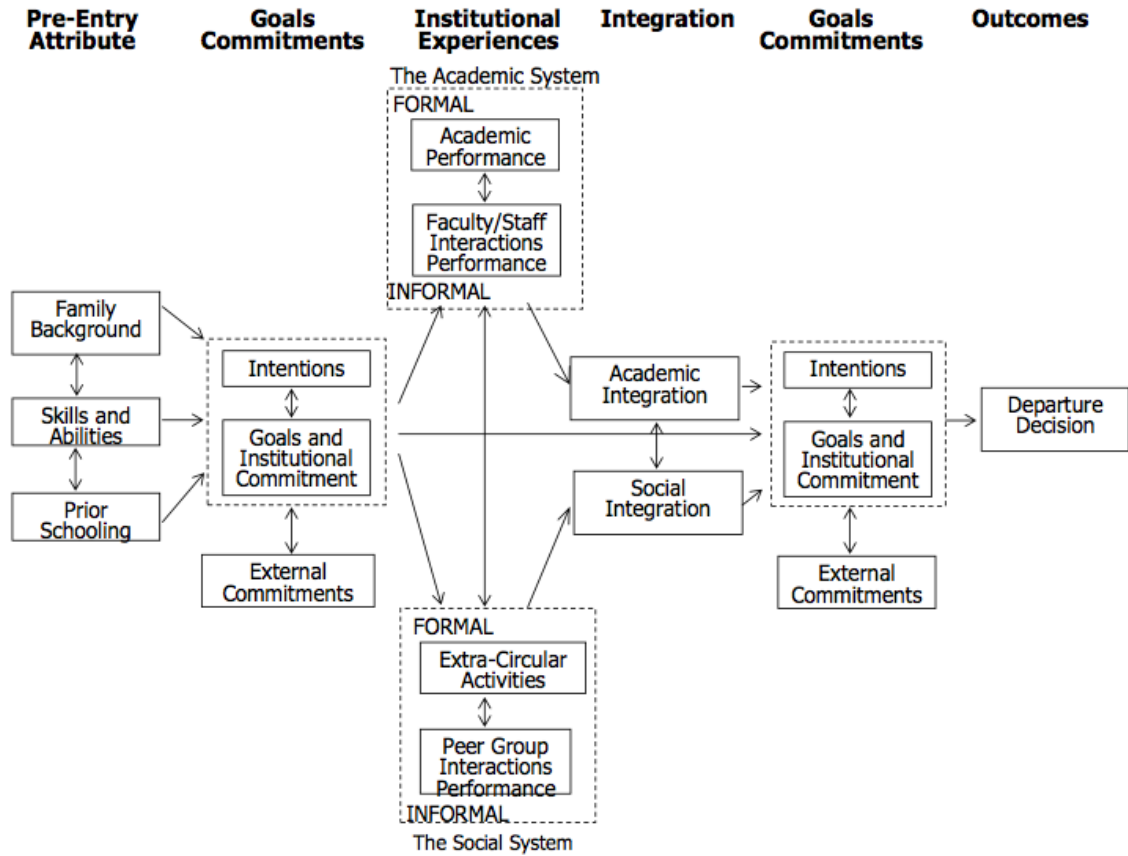


Figure 2.3. Tinto's theory of student integration [Tinto, 1987]

theory of involvement requires students to actively participate in their own learning processes.

Examples of empirical evidence of integration and involvement in higher education are varied. Rhodes and Nevill [Nevill and Rhodes, 2004] examined through the use of a satisfaction and dissatisfaction survey and how these impacted the academic and social of the students. Among their findings, it is notable that dissatisfying factors, such as poor teaching and inability to cope with their workloads, harmed academic and social integration. Also notable is that stimulating and exciting courses were seen as positive for integration. Other studies showed that peer mentoring helped students transition to university and showed higher levels of social and academic integration [Collings et al., 2014]. This, however, is one of many studies supporting this proposition, as others have supported this conclusion [Hixenbaugh et al., 2006]. In both studies, peer mentoring

meant students helped each other through their learning process. In the domain of involvement, studies such as the one by Gardner & Barnes [Gardner and Barnes, 2007] showed the importance of social involvement, particularly among graduate students at a college level. Students recognized its importance and how it can impact their goals and future plans. Harper & Heiberger [Heiberger and Harper, 2008] examined how they could use Facebook to the student's benefit and how it could be used to increase involvement. Facebook was used as a tool to increase their means of communication and to be able to find opportunities that suit their own interests, which in turn increased their involvement.

Involvement and integration mean that students need to feel part of a social circle that encompasses the classroom or, at a higher level, society. Feeling integrated and involved helps students have a sense of belonging that translates into better academic experiences. Studies such as the one by Harper & Heiberger prove that modern technologies can help students and faculty deal with integration and involvement. Furthermore, as we have seen in our work, while technology can help with integration and involvement, teaching is an essential part of integration, leaving students socially stranded and without interest in their peers and learning experience.

2.2.2 Engagement & Motivation in Education

Student engagement has often been linked to higher academic performance [Addison et al., 2009, Bakker et al., 2015]. Nonetheless, researchers and educators need to be careful and consider it a silver bullet for students' academic performance. The first of these studies that linked engagement and academic performance is the one by Carini et al. [Carini et al., 2006], where they examined the apparent correlation between student engagement and academic performance. In their study, academic performance was measured by multiple tests and it found that while student engagement did correlate with academic performance, other factors in play might affect it as well. Others [Zhao and Kuh, 2004] explored the relationship between learning communities and student success to find a positive correlation between these two. The correlation between student engagement and student success or academic performance is rather clear. However, even

after considering these prior studies, we still need to understand how to effectively increase students' engagement fully. Literature [Parsons and Taylor, 2011] can tell us that student engagement can be improved by changing the methods and how instructors teach. It also informs that the relationship between students and teachers should be one of peers where students can challenge and interact with each other. We know that students can be more engaged with their academic goals and aspirations through integration and involvement. Studies have also shown that students want to participate in their coursework and have ownership of their learning process and get feedback which modern methodologies try to accomplish but do not quite meet these needs [Dunleavy and Milton, 2009]. Lastly, research also examined the importance of course design, learning experience, and how it impacted students' engagement as they gained more authority and control over their own learning [Fink, 2007]. Flipped classrooms, an approach in which students need to complete some preparatory work prior to class (videos or readings) and then use in-class time to collaborate with peers and problem-solving, have also been tested as a way to increase student engagement [Smallhorn et al., 2017]. Arguably, the latter study's authors suggest this is caused because students can receive in-time feedback about their learning.

Like engagement, motivation is often touted as one of the main driving forces in the learning process [Williams-Pierce, 2011]. Prior work has shown that when students feel and are more motivated, they start paying attention to their lectures, ask questions, and generally interact more with the classroom and course content [Palmer et al., 2007]. Generally, students want to perceive a meaningful experience in their work, a sense of competence, and to a certain extent, control or autonomy. Similarly, a sense of meaning and control emerges from the interaction between students and faculty [Seifert and O'Keefe, 2001]. Occurrences such as the pandemic, financial problems, debt, and family issues have been shown to impact students' motivation. For example, a survey study explored the changing trends in social interaction among students and its effect on mental health, only to discover that a lack of motivation was a common issue found among students [Hemanth, 2020]. There is one specific instance where students have

particularly struggled: online courses. Research into the subject has shown that students were not adequately enthusiastic about online classes [Fang,]. Motivation to learn, more explicitly learning motivation, has long been associated with satisfaction [Bekele, 2010], hence why satisfaction is considered paramount in improving the learning experience. Literature on this topic is not scarce, and experiments have been conducted to find the main determinants of motivation or the factors that contribute to its boost. Findings among scholars varied but found that the main determinants for motivation are not easily caused by one factor alone. For example, some studies concluded that one determinant for motivation among students was the perceived learning outcome [Alhadi and Saputra, 2017], others found that intrinsically motivating activities, tasks and materials were a driving factor [Nikolov, 1999], teaching strategies [Oroujlou and Vahedi, 2011], and a robust student-instructor relationship [Gares et al., 2020].

However, how can we ensure that we can increase student motivation even if we implement specific strategies or activities? This has been examined in some instances, and some conclusions have been found to this educational challenge. Wang et al. [Wang et al., 2008] approached this by using different questionnaires to measure learning motivation, self-efficacy, and learning strategies. Their findings suggested that learning strategies, looking at learners' intrinsic motivation and supporting multiple types of cognition, can increase learners' motivation. In addition, they also found that providing students with a sense of self-efficacy and specifying the learning objectives clearly. Different tools have also been tested to increase motivation, finding that using videos as a teaching approach [Madarash-Hill and Hill, 2004] helped students gain a more positive outlook about their perceived motivation. Multiple Intelligence Theory [Gardner, 2011] has also been tested to improve student motivation, which proved to increase motivation and suggested the need for various types of support and guidance [Ahmad et al., 2015]. In this vein, researchers also found the importance of aligning classrooms' content to students' personal goals and aspirations [Frymier and Shulman, 1995].

2.2.3 Self-Determination Theory

Self-Determination Theory [Deci and Ryan, 2012] is a theory of motivation that aims to explain a person's intrinsic and extrinsic motivations. The theory posits that there are three main facets as to how an individual is intrinsically motivated. These being: *Autonomy*, *Competence* and *Relatedness*. Each of those is related to different aspects of motivation. Autonomy relates to the need to control one's life and the desire to act according to the integrated self. Relatedness is tied to the sense of belonging, connectedness, and caring for others. Competence is the need to feel competent, effective, and have control over the outcomes. On the other hand, extrinsic motivations (also called extrinsic rewards) are governed by external factors or rewards such as grades, recognition, or feedback. This aspect of motivation is particularly important in those cases where the task to be carried out is not intrinsically motivating. These two aspects of the theory are what drive people and motivate them. However, there are instances where changes in one of the prior three facets can negatively impact both intrinsic and extrinsic motivation. For example, if the person is not competent enough, it might leave the individual *amotivated* without any motivation towards the activity. This leaves us with a few conclusions, first is that individuals are multifaceted in terms of motivation. That means that any self-regulated approach to CMC can target a specific facet without necessarily being at risk of losing a student's motivation. Second, is that self-regulated CMC can trigger and target intrinsic motivation by resorting to the three main facets present in this type of motivation. It can do so by giving students the control they might seek after their education, amplifying their sense of connectedness and belonging by communicating with others, and feeling competent while doing so. However, we need to keep in mind that sometimes adding something such as feedback and recognition can add to that extrinsic motivation, specially in scenarios such as ours, where intrinsic motivation as we have seen might not be enough to affect interaction and motivation.

2.3 Computer Mediated Communication

Modern technologies have become ubiquitous in current classroom environments. We can acknowledge that thanks to smartphones, modern computers, and other devices, it is easier than ever to communicate with each other and students are perceptive about that. It is why making use of these types of technologies and means of communication can help students and instructors. In this technology-assisted communication domain, we used what is called *Computer-Mediated Communication* or CMC. Computer-mediated communication can be defined as the process in which individuals exchange information using networked telecommunications systems [Romiszowski and Mason, 1996]. Using this definition certainly brings to mind systems such as emails, text messages, or, most recently, Zoom. However, among those, a notable difference affects the implementation of CMC in different environments. That is, whether the communication occurs in real-time (synchronous) or not (asynchronous). An example of asynchronous CMC refers to those methods of communication in which the communication does not occur in real-time (delayed). Some examples of this type of communication include text messages, emails, and videos. On the other hand, synchronous CMC refers to methods of communication that occur in real-time, some of these examples being: Zoom, FaceTime, and any form of video or voice call. In both cases, one of CMC's benefits is that there are no temporal or spatial constraints; that is, communication can occur at any given time in any given place [Kiesler et al., 1984].

2.3.1 Benefits and Constraints

Computer-mediated communication (CMC) has been examined in a multitude of different scenarios, and that is why literature is abundant. CMC has some clear distinctions from face-to-face communication. First, CMC differs from face-to-face communication in that there are some limitations to the cues one can gather from this type of communication. For example, the first things to go out of the window when applying CMC in any environment are social cues and social presence. Social presence, as defined by Short et al. [Short

et al., 1976] are those cues that make a person feel like "a real person". This social presence varies depending on the medium that is used, which means, videoconferencing generates more social presence than talking through email or text messages. We need to bear in mind that there is no equivalent for face-to-face interaction in the domain of CMC. Similarly to social presence, we also have social cues that are generated through face-to-face communication. In this aspect, social cues refer to those characteristics found in everyday interactions: the environment where the communication takes place, the location, the noise, and such [Dietz-Uhler and Bishop-Clark, 2001]. In addition to these environmental cues, there are also non-verbal cues and behaviors that are found in face-to-face communication. These elements are completely removed from the equation in scenarios such as the one found in asynchronous CMC. This causes CMC to always fall behind face-to-face communication even with modern technologies such as video conferencing.

However, CMC offers some advantages despite its shortcomings mentioned above. Early work in the domain of CMC by Warschauer suggested that this type of communication could help to promote collaborative learning [Warschauer et al., 1996]. He suggested that concepts such as critical thinking and problem-solving were a byproduct or tied directly to any conversation, regardless of whether this happened face-to-face or through other means of communication. This applied in both synchronous and asynchronous CMC. Other authors [Kiesler et al., 1984] noted and argued that the "impersonal and free" nature of CMC was an advantage as it allowed individuals to interact more conveniently as compared to face-to-face communication. Siegel et al. [Siegel et al., 1986] argued that when applying CMC to a group of people, these felt more inhibited as they actively pursued immediate cues within the messages instead of the behavioral cues that are present in face-to-face communication. As [Dietz-Uhler and Bishop-Clark, 2001] writes, CMC allows individuals to feel more comfortable and open to sharing their personal information and put more effort into the discourse. All these characteristics, which can be summed as the capacity of CMC to allow individuals to be "more themselves" and not focus as much on the social and behavioral cues, are what grants CMC its unique

qualities and benefits.

2.3.2 Media Richness Theory

Given CMC's benefits and detriments, which we have seen that there are cases for both, there is a theory that remains highly relevant in the field of CMC. First introduced by Daft & Lengel [Daft and Lengel, 1986] it is named *Media Richness Theory*. The theory aims to explain how different forms of media have different levels of richness in the information they provide. Originally the theory was conceptualized as a means to explain how organizations process information and why they do so. Since then, the theory has been used in a multitude of fields and disciplines. The theory is based primarily on two main assumptions on how information is processed in organizational environments. The first assumption is *Uncertainty* which, according to Daft & Lengel it is the absence of information, and that is where data and communication can fill in the gap and lower uncertainty. The second assumption is *Equivocality*, and that is explained in their theory as the different interpretations of information that can happen at any time; in this case, high equivocality means that there is not a clear understanding. Based on these two assumptions, Daft & Lengel proposed their first suggestions on how to solve this information processing issue (Figure 2.4).

Based on these assumptions, Daft & Lengel theorized that different media had different richness as their ability to communicate and effect understanding changed based on it. This richness is set up on a continuous scale in which face-to-face communication stands at the higher edge of media richness, and the other means of communication are on the opposite end, with asynchronous communication, such as mail, being at the other end, as depicted in Figure 2.5. For example, from what we have seen in this chapter, asynchronous methods of CMC have a low level of media richness, mainly due to the lack of social cues and context. Conversely, synchronous CMC, in particular methods such as video conferencing, is close to face-to-face communication in terms of its effectiveness, as it allows individuals to see social and context cues.

As we have seen previously in this chapter, asynchronous methods of CMC would

richness. These are: *Ability to handle multiple information cues simultaneously*, *Ability to facilitate rapid feedback* and *Ability to establish a personal focus*. Then again, we see that among those characteristics, face-to-face communication remains the optimum means of communication. This means that different environments allow for different richness in their communication.

Media Richness Theory has been examined and used in the educational field. One domain where this has been studied and examined is online courses and e-learning. Naturally, online learning can benefit the most from an informed approach to media richness theory as their communication means differ from those of in-person learning. There have been attempts, such as the one by Sun & Cheng [Sun and Cheng, 2007] to inform e-learning using media richness theory. Their study found that high-richness media benefited e-learning courses with high levels of uncertainty and equivocality. Furthermore, studies in the domain of online and distance education examined the effects of increasing media richness on student satisfaction, concluding that environments with higher media richness reported more satisfaction, resulting in more communication among students and faculty [Shepherd and Martz Jr, 2006]. The study of media richness theory also extended to online discussion forums [Balaji and Chakrabarti, 2010] that helped understand how using multiple mediums of instruction enriches communication and improves learning. Media Richness Theory is an important framework to consider as it discusses the different levels and types of communication available and how they can be used to process information. Media Richness Theory offers insight into how computer-mediated communication can be applied and how communicating through non-traditional means can affect learning and student satisfaction. Hence, why in our approach, we decided to provide students with a tool that had both asynchronous and synchronous components, such as video chatting, to increase the richness of our provided medium.

2.3.3 Asynchronous computer-mediated communication in Education

The main focus of our study resided in applying asynchronous CMC in an educational context. However, our tool had synchronous components, hence the importance of reviewing the work that has been conducted in this domain. The first of these studies we can look at is the one by Rayl et al. [Rau et al., 2008], in which the use of SMS (Short Message Service) and E-mail was used to send students reminders about their assignments and learning material. The study showed that student pressure decreased among students using this system and increased their bonds. As students are nowadays expected to have a smartphone with them and be proficient in their use [Thornton and Houser, 2005], approaches like this can be easier to implement. Similar studies, and more recent [Mellati and Khademi, 2014], have investigated the effects of CMC for peer evaluation in English writing. In this study, Mellati & Khademi found that allowing students to communicate via e-mail and provide feedback created an environment where peer learning thrived due to increased cooperation and collaboration. CMC has also been compared to face-to-face collaboration [Ocker and Yaverbaum, 1999], showing that learning was not directly impacted by using either face-to-face or CMC. However, satisfaction often declines even if learning stays the same. This is a motivation for a self-regulated approach in which students can support each other. In addition, there is a common thread among many studies of CMC, and that is most of them require external intervention from the faculty or the researcher.

2.4 Self-Regulation

To better understand why we chose our approach and methodology for CMC, we need to understand a meta-cognitive process called self-regulation. In the context of our work, that is, education and learning, self-regulation alludes to student's ability to adapt and control their own learning processes [Zimmerman, 1990]. In the case of students, it is a process that is done actively, meaning that students seek to compensate when they believe their learning experience is lacking and accept their responsibility within the learning

experience [Zimmerman, 1989]. Moreover, through self-regulation, students can identify which strategies might work for them and which ones do not [Baker, 1984]. However, it is important to know that self-regulation occurs on a spectrum, meaning that students are able to self-regulate to varying degrees. This is to say that students will use different strategies to self-regulate and effectively analyze which ones work best for them. It is important to note that students are constrained as they need their environments to give them a certain space and sense of autonomy [Schunk and Ertmer, 2000]. This highlights the importance of giving students enough freedom and control over their education for this process to occur. Most importantly, as Bandura put it [Bandura, 1986], humans do not take a passive approach to learning; instead, we actively attempt to control our own learning environment.

However, what are some of these techniques that students make use of when we speak about self-regulation? These generally involve different techniques that might or might not work for them, monitoring their own progress as part of their learning experience. According to [Wandler and Imbriale, 2017], some of these might take the form of journaling their progress, receiving tutoring, and reaching out to faculty when they are struggling or they deem it required for them to progress further. This is of particular importance for the educational domain and learning because it allows students to gain more control over their education and learning processes [Schunk and Ertmer, 2000]. In addition, students who use self-regulation and develop these strategies are generally able to tackle challenges and difficulties that otherwise they would be unable to [Pintrich, 2000]. In general, it helps students become more independent, self-sufficient, and successful [Sahranavard et al., 2018].

2.4.1 Applications of Self-Regulation in Education

As we have mentioned, self-regulation is a critical skill for school success. These skills can help students inside the classroom reach their goals and aspirations and serve them effectively outside of the classroom. However, how is self-regulation applied and used in the context of education, and what strategies can be used to promote and help students

develop this skill set? One of the early strategies identified in this domain is done by one of its most prominent figures in this domain, BJ Zimmerman [Zimmerman, 2000]. This is *self-observation* or *self-monitoring*. This performance control strategy as Zimmerman described, involves tracking and observing one's behaviors, emotions, performance, and the conditions surrounding these three. This allows students to notice where they are struggling and make corrections to effectively improve [Spooren et al., 2017]. Usually, through self-monitoring, students can reach a stage of *self-experimentation* [Bandura, 2001] that allows them to test different approaches to their learning experience.

A second strategy that helps and encourages self-regulation is that of *goal-setting* [Locke and Latham, 1990]. Briefly, goal-setting provides the students with clear goals which they can use to develop a planning strategy to reach these. However, we need to understand here that two types of goals can be set up for students [Sandars and Cleary, 2011], process goals and outcome goals. These two differ in that outcome goals define the final product of an activity, while process goals refer to the strategy and adjustments needed to complete the goal. This is key for learning because providing students with goals can motivate and engage them to create and plan according to those. Additionally, goal-setting, as we have seen throughout this section, has been linked to higher academic performance and engagement among students [Zimmerman and Schunk, 2011]. In fact, it is shown throughout the literature that students at different academic levels have entirely different goal-setting structures, which lead them to either underachieve or not [Pressley and Ghatala, 1990].

Some applications of these strategies can be found in modern (and not-so-modern) literature). An example application of self-observation through journaling is the study by Schmitz & Schmidt [Schmitz and Schmidt, 2011]. In their study, the authors implemented a journal system for 49 students where they had to answer questions regarding their learning experience. The application of the journal showed an increase in the student's sense of self-efficacy and motivation. In terms of goal-setting Bol et al. [Bol et al., 2016] used in their study four self-regulated learning exercises (which were based on Zimmerman's) to test the effectiveness of a self-regulated intervention on community

college students. Their results showed that students who received training and learnt effective goal-setting techniques and strategies performed better than those who didn't

As the literature points out, self-regulation is often a marker between high and low-academically performing students in college. In a study by Kitsantas [Kitsantas, 2002] where they investigated the importance of these self-regulation techniques and strategies, they found that students who used these strategies performed better than their counterparts. However, as we have reviewed, some of these approaches often require external supervision or intervention. Hence, we combined self-regulation with CMC to study whether students could self-regulate their learning processes when left to their own devices.

2.4.2 Self-Regulation and CMC in Education

As we have seen, the CMC approaches in education can bring many benefits to students and their learning experiences. As CMC has become more ubiquitous, it seems natural that self-regulated approaches to CMC would emerge. Allowing for self-regulated behaviors to emerge can improve learning outcomes [Zimmerman and Schunk, 2011] while also helping students feel more in control of their experiences. Studies have shown that using self-regulated approaches to CMC resulted in higher academic achievement and more satisfaction with their learning experiences, especially regarding difficulty and challenging topics [Azevedo, 2018]. Additionally, CMC's online environments create the perfect test bed for self-regulation as it can lead students towards help-seeking behaviors [Karabenick and Newman, 2013]. Moreover, the literature points out that students need to be self-regulated and self-directed in online and in-person environments [Delen and Liew, 2016].

To see some of these applications of self-regulation in computer-mediated communication environments, we can rely on more modern literature to see how these approaches have been conducted. One example is the study conducted by Cho et al. [Cho et al., 2010]. As they applied Zimmerman's SRL framework [Zimmerman, 2000] and investigated students that were present in online learning environments, they found that students

regulated their interactions and behaviors to make sense of their learning experiences in those social environments. Additionally, other studies [Yukselturk and Bulut, 2007] found that intrinsically motivated students that were present in asynchronous online learning environments tended to use more self-regulated strategies. Moreover, students who enjoy increased interaction with others contribute more towards online communities and engage more in reflection and responding strategies [Cho and Jonassen, 2009].

However, the application of entirely self-regulated Computer-Mediated Communication methodologies has remained rather scarce, and research is still ongoing, and results are contentious [Cho et al., 2010]. Through our work, we hope to expand this body of literature where a different self-regulated approach to CMC is explored and tested. The next section discusses the methodology we followed to create our experiment and analyze our results.

Chapter 3 |

Research Methodology

The primary objective of this study was to investigate a new approach to self-regulated computer-mediated communication (CMC) in different undergraduate and graduate classrooms. We did so considering factors such as technology adoption, engagement, and media richness. We also factored the potential impact it could have on both students and faculty. As we recognized the need for faculty members to reduce their workloads in these approaches we aimed to implement a tool that was deemed as user-friendly, useful and could facilitate adoption. However, due to the nature of our experiment the recruiting process proved to be challenging and lengthy as it needed several meetings with faculty to clarify the aims of our study.

3.1 Computer Mediated Communication Approach

As we have seen throughout the literature, many different ways to implement CMC strategies in a classroom environment exist. However, these approaches often increase the workload for faculty members and researchers. As a result, these approaches are not typically self-regulated nor self-directed, or truly independent of external factors. Our initial aim was to examine whether students could become active participants, collaborate, and communicate with each other without an extrinsic motivation, without apparent reward or incentive. Furthermore, we wanted to investigate the effectiveness of such an approach for long-term use. Hence our research methods mirror our initial aim. However,

as our final results did not meet our expectations, we embarked on a path to learn the challenges students were faced with and provide a solution for those.

3.1.1 Software Procurement Process

We established specific criteria when selecting a tool for our experiment. Using what we learned from the literature, we sought a tool that facilitated adoption, was easy to use, and simple while also providing richness to communication. Moreover, we considered how its benefits could overcome its effort to learn and adopt. To meet the criteria, we identified minimum features and characteristics that this should have.

When we explored potential tools, we became aware that to fulfill our criteria and meet students' needs we had to search for a tool that was already widely used in academic or professional settings. This was primarily done to keep in mind and satisfy the ease of use and perceived usefulness criteria we set out for ourselves. To do so we resorted to modern literature to investigate what tool students could be familiar with [Cook et al., 2019, Lu, 2022, Ly, 2020, Mason and Carr, 2022]. We realized, as we will see later in this study, that students had a plethora of options available to them. However, as ease of use was a requirement that could be fulfilled relatively easily, perceived usefulness would be more challenging as having this many options could substantially vary perceptions. For easy adoption, we determined that a widespread tool with considerable recognition would be the best option. Nevertheless, providing richness to communication was a criterion that proved more limiting.

One of our key objectives was to provide students with means of communication that could always be available as per the Media Richness Theory [Daft and Lengel, 1986]. Hence we looked for an application that would allow students the option of not just texting but also allowing them for videoconferencing whenever they deemed necessary. As such, our search yielded a few common tools that are common throughout society. These popular platforms were Discord, WhatsApp, GroupMe, Slack, Microsoft Teams, and Snapchat.

Most of the apps we reviewed met our designed criteria, but still, we had to consider

some additional factors. For instance, one of these was privacy. We wanted to avoid apps that, for sign-up, relied on private information like phone numbers or personal email accounts (that is not within the PSU domain). We also wanted a tool that could be monitored externally, as required by our IRB, and keep track of student behavior within the platform. Additionally, we needed and wanted an app with a flexible user experience and features that allowed for the creation of groups, channels, and sub-channels so students could organize themselves and communicate as they deemed necessary. Lastly, the platform also had to allow for monitoring while the experiment was running to ensure compliance with Penn State's school code of conduct.

Setting these additional criteria allowed us to eliminate several potential apps from our list of candidates for our experiment. GroupMe, WhatsApp, and Snapchat were among the first to be rejected due to their violation of our privacy and confidentiality criteria, as these apps required a phone number to use. As we have said, we aimed to avoid using private information beyond students' PSU email and names. Additionally, these apps lacked enough functionality to create groups, subgroups, or sub-channels, making it difficult for students to organize themselves and give them enough control over the platform. While these apps met the initial criteria as they allowed for easy text messages and video conferencing, none facilitated an easy integration to organize groups, especially in apps like GroupMe and Snapchat.

Therefore, after all the filtering, we were left to choose between Discord and Slack. Both of these have been widely used in academia and CMC and other experiments [Odinokaya et al., 2021, Wahyuningsih and Baidi, 2021]. The first of these, Discord, is a platform commonly used by gamers. However, it gives users a lot of flexibility and customization options. More importantly, it has neat organizational features and functionalities, as well as roles that can be assigned to different members. It also had a good reputation for privacy and security. However, one crucial downside is that messages cannot be monitored externally, meaning if there were to be a break of code of conduct, the school or any governing body could not look at past messages.

On the other hand, Slack was a more professional-oriented app used in the industry,

with a more straightforward design and easier to use. Due to industry-related design, it has fewer customization options than Discord but still allows for clever organization features and functionalities. Additionally, it is also known for its reliability and integration with other software and tools.

After these considerations, we ultimately decided to use Slack as the platform for our implementation due to several reasons. First, it had been widely used in previous studies with successful outcomes, which gave us confidence in its efficacy. Second, we felt that it was a user-friendly platform that would be easier for students to adopt while still meeting our criteria. We also deem that Slack struck a balance between being a relatively well-known application to students while also having a professional tone, thus not interfering too much with their personal lives. Additionally, we believe its integration with other software and tools could be useful for future implementations.

3.1.2 Using Slack, Sending Invitations and Accepting Invitations.

Slack gives users different options to choose from based on their needs and preferences. However, these were not a critical factor in our decision-making process, it was a selling point for us. To start using Slack two things are required. First, users must be invited to a Workspace, which means being invited to an already existing group using the platform. Second, they need to either create a new account or use an existing one. Similar to other platforms, Slack has both free and paid versions. The free version, which was used for this study, provides access to all essential features, with some limitations. For example, messages older than 90 days cannot be accessed unless pinned. Additionally, the file size limit is 5GB for the entire Workspace. We determined that the additional features provided by the Pro version were unnecessary for our study, similar to other research studies [Odinokaya et al., 2021].

The easiest way to access Slack is through their website *www.slack.com*. Once a user is invited to a workspace and logs in, they are directed to a screen displaying the different groups they have access to or have been invited to (see Figure 3.2). After joining a workspace or selecting a pre-existing one, there are several options available to

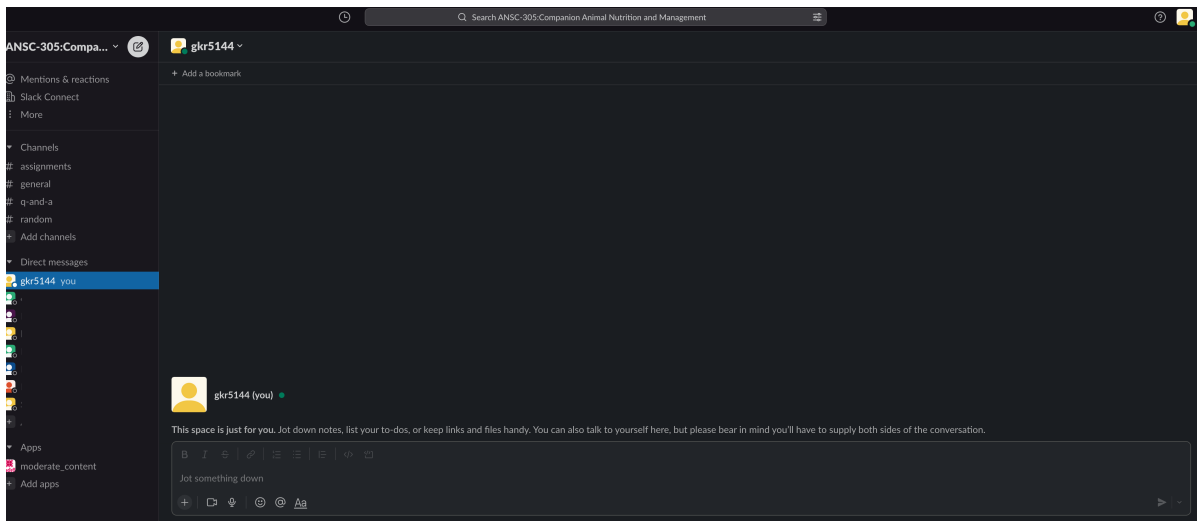


Figure 3.1. Slack Desktop Application

begin using the platform. One is to be used through their website application, desktop application (Figure 3.1), or mobile application. Despite the availability of these different applications, all functionality remains the same across devices without any limitations on what can be done.

To be invited to a workspace can occur through two different methods. The first method is through direct invitation, where the admin uses the person's email to be invited. The invitee then receives an email indicating the workspace's name and an option to confirm their acceptance of the invitation. This process lets admins be cautious about whom they invite to their channel and who becomes a member. The second method of inviting people is through a shareable link (See Figure 3.3). This way the admin of the workspace can enable an invitation link, which grants access to the workspace in question when clicked. This method allows for bulk invitations, as the link is open for anyone to use. Additionally, it enables individuals to be invited without email addresses if the admin does not possess that information.

After being invited to the platform, the main channel created by the admin is the first thing users see upon logging in. From there, users can navigate to other channels (see Figure 3.1) if those channels have been created and made visible to the user. Users can also send direct messages to others who have joined the workspace.

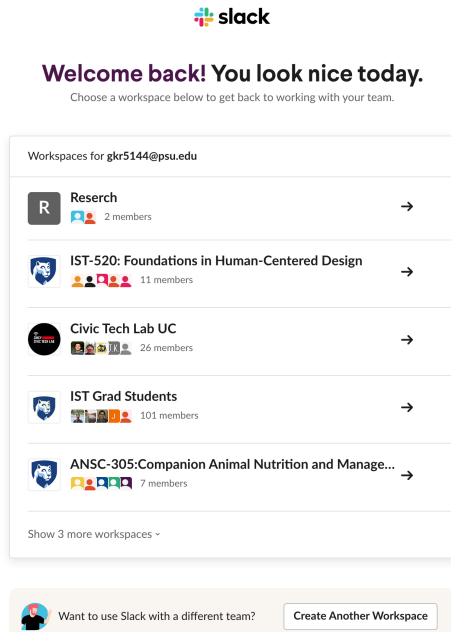


Figure 3.2. Slack Group Workspaces

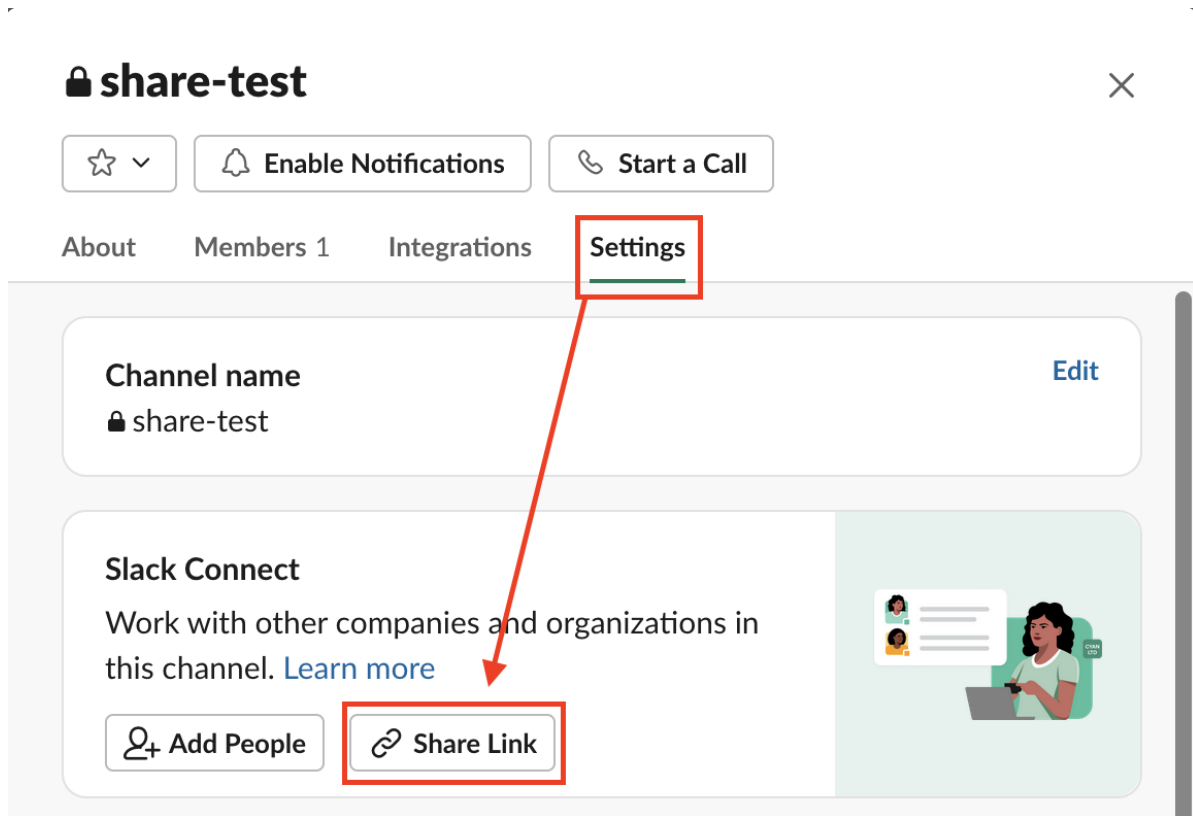


Figure 3.3. Slack Shareable Link

3.1.3 Features

Like many other instant messaging apps available today Slack is designed to facilitate communication between users through real-time texting. Once users accept an invitation to join a workspace, they can immediately start messaging each other through the platform. However, while messaging is its primary purpose, Slack offers some additional features. For example, users can react to others; messages using emoticons or small animated GIFs. Similar to Discord, Slack allows users to use custom emoticons that they can upload from other platforms or websites and custom small animated GIFs. This customization feature gives users greater control over how they interact with others [Tuhkala and Kärkkäinen, 2018].

Slack offers a comprehensive range of text editing features, including basic formatting tools such as Bold, Italicize, and Strike-through. Users can also create numbered and bulleted lists, quotes, and code snippets or blocks. The platform also supports video and audio recording for more immersive communication. Unlike other tools like Discord, Slack allows users to send files with fewer size limit restrictions. Furthermore, one of the factors that led us to select Slack was its videoconferencing capabilities. This feature allows for real-time face-to-face communication, which, as we have seen throughout literature, can enhance the richness of communication among members [Daft and Lengel, 1986].

We considered the rich set of features offered by Slack, compared to other alternatives like GroupMe and Snapchat, as one of the key reasons for selecting it as the collaboration platform for our study. Hence, we believed that Slack could provide a more than suitable environment for students to interact, collaborate, and share academic and extracurricular information.

3.1.4 Recruiting procedure (1 of 2)

The recruitment procedure was divided into two different stages. The first stage was recruiting faculty members, and the second stage was recruiting students through an in-class presentation.

3.1.4.1 Recruiting Faculty

The recruitment phase of our study followed a multi-step process. First, we obtained, and used a list of faculty members who had previously agreed to be contacted for research purposes. This list we had access to was obtained through previous research [Tsai et al., 2020, Li et al., 2022]. However, even if we had access to this list, it was not our property but instead TLT's (Teaching and Learning with Technology department). Hence, prior to reaching out faculty we arranged a meeting with them. During this meeting the purpose of our study was clearly explained, as well as any possible risks, expected outcomes, and methodology. After we were approved to use the list we had on our hands, we contacted faculty members via e-mail.

During this recruitment phase, we contacted 86 faculty members who expressed interest in participating in our research. To ensure that the faculty members were eligible for the study, we restricted the recruitment to those who taught at the main campus (University Park). We conducted the recruitment in March and April to avoid the summer months, during which faculty members could have been less available. The e-mail template used for recruitment (shown in the appendix) provided a brief overview of the study and its procedures and invited faculty members to a Zoom call follow-up if they had any questions or were interested in participating. Approximately ten faculty members responded, expressing either interest or lack thereof due to class conflicts. It is worth noting that we contacted a large number of faculty members due to the potential challenges we anticipated in convincing them to participate in our study. We understood that our implementation could potentially disrupt the classroom balance or make some faculty members feel less in control of their students. Following procedures similar to those found in literature [Tuhkala and Kärkkäinen, 2018, Menzies and Zarb, 2020], we aimed to have a minimum of two courses where our experiment was implemented so that we could compare interactions between them.

Once we received positive responses from interested faculty members, we sent them an initial written proposal and scheduled a Zoom meeting to discuss any questions or concerns they may have had. Out of that group, three faculty members showed clear

interest and were open to implementing our approach into their classes. However, due to the timing of the recruiting phase, which occurred during the Spring semester, we had to make arrangements after the summer to start planning the work and contact them again. During the summer, our team maintained contact with one faculty member who showed clear interest, but the other two were unreachable. As the Fall semester approached, we reached out to two other faculty members who were part of our study committee and explained the purpose and intent of our study. They both agreed to participate, along with a third faculty member who was recruited via e-mail. This gave us more alternatives than we initially planned for and aimed for (see table 3.1 for list of courses).

It is essential to mention that due to the un-moderated approach to CMC and IRB restrictions on faculty involvement, the recruited faculty members from the committee were unable to intervene or affect the study in any way. While they were interested in seeing the study conducted, they could not interfere with it in any capacity.

3.1.5 Courses Implemented

Course	Level	Form	Department
IST-402	Undergraduate	In-person	IST
IST-520	Graduate	In-person	IST
ANSC-305	Undegraduate	In-person	ANSC
ANSC-215	Undegraduate	Online	ANSC

Table 3.1. Courses Implemented

While we originally planned to have only two courses for comparison, adding two committee members to the study gave unexpected richness to the experiment. One of the recruited faculty members taught two courses in the Animal Science department (ANSC) during the Fall semester. ANSCI-215 was a required course for the major and was entirely online, primarily discussion-based, while ANSCI-305 was an in-person lecture course

and an elective. Despite having similar class sizes (around 30 students), the courses had different methods of delivery, making them important additions to the study. It was also noteworthy that these courses were taught outside of the Information Science & Technology (IST) department, where students may have been more accustomed to technology and novel approaches to teaching.

The inclusion of the IST-420 and IST-520 courses, from where our committee members were instructors, enriched the study and made it more diverse than initially anticipated, or so we thought. IST-420 was an in-person lecture-based undergraduate course within our own IST department that emphasized group work and weekly presentations on emergent technologies. The course had approximately 50 students and provided a different perspective than the Animal Science courses. IST-520, on the other hand, was a core course for Ph.D. students, with weekly discussions and readings on various HCI topics. It was also an in-person course and provided an opportunity for a contrast with the other courses where all students were undergraduates. These additions allowed us to leverage the differences between courses and gain a better understanding from different perspectives on why our Slack suffered its challenges and failed to meet its expected goals.

3.1.6 Workspace Creation & Characteristics

Once we coordinated with faculty members and agreed to implement our approach in their courses we embarked on designing the multiple workspaces for the students to collaborate on, taking into account prior literature and ensuring that they were structured in a sensible way to facilitate collaboration.

We started the design process by creating four separate workspaces, each corresponding to the course where the study would be implemented. The workspaces were named after their respective courses, namely IST-402, ANSCI-305, ANSCI-215, and IST-520. Each workspace was then divided into four channels, allowing students to communicate without any restrictions. The channels were named *Assignments*, *General*, *Q&A*, and *Random*. This was not only done as inspired by prior literature [Menzies and Zarb,

2020, Tuhkala and Kärkkäinen, 2018] but also to encourage different levels of engagement, conversation, and collaboration. Our rationale was that the *Assignments* channel allowed for discussions related to any assignments that students had for their course or others. The *General* channel was created as a multipurpose space where students could discuss course-related matters. The *Q&A* channel could be used as a platform for students to ask and answer questions related to the course. Lastly, the *Random* channel allowed students to share and discuss anything they wanted, giving them a sense of freedom and creativity within the workspace.

However, to ensure adherence to the university's code of conduct and maintain a level of civility, we initially limited some functions and permissions for students when designing the workspaces. Specifically, we did not allow students to become admins of the workspaces, at least from the beginning. Instead, we required them to contact us for any changes or additions to the workspace. However, during student recruitment, we informed them that they could take leadership roles and become admins of the workspaces, granting them the necessary rights to manage the groups, its members and the overall interaction within the workspace. With our faculty, courses, and workspace design finalized, the next step was to recruit participants from these courses and add them to the corresponding workspaces.

3.1.7 Recruiting procedure (2 of 2)

3.1.7.1 Recruiting Students

To comply with IRB guidelines and ensure that faculty did not know which students participated in the study, we had to recruit volunteering participants and explain the study in detail. We started by creating a recruitment/consent form (see Appendix) that outlined the study's purpose, potential risks (none besides potential loss of privacy), and incentives for participation. Within the consent form we also provided our contact information in case students had any questions or concerns. The form included fields for students to provide their name, date, email address (which was needed to add them to

the study), and a signature indicating their agreement to participate.

To recruit students from these courses, we conducted in-person presentations during the second week of the Fall semester for all courses except for ANSCI-215, which was online, in which case a video presentation was uploaded to their canvas course. This timing was chosen to allow students to settle into their courses before introducing them to this additional communication channel. The presentations lasted between 5 to 10 minutes and included an outline of the study, going over the possible benefits students could get by participating, and a clear explanation that students were free to use their workspaces in any way they wished, as long as they followed the Penn State code of conduct. We made it explicitly clear that faculty members would not have access to the platform or workspace and could not see who enrolled in the study. Copies of the recruitment form were distributed during the presentation for interested students to read and sign if they wished to participate.

Across all four courses, 30 students agreed to participate in the study and joined the workspace during the second week of the semester. As we were about to find, many students were attracted to the idea of meeting new people through the platform. Once students agreed to participate in the study, we added them to the corresponding workspace and sent them an invitation which they had to accept to join.

3.1.7.2 Inviting and Accepting Students

Adding participants to the workspace was a multi-phase process primarily because we could not streamline it as much as we would have liked it to. In this first phase of invitation which lasted about a week and a half, we added students to the workspace via email link after they had consented to be part of the study. Although this method had the potential to be an entry barrier since the invitations would be sent to their PSU emails meaning students had to be aware of their emails to enter the workspace, we could not find a way around it. To address this issue, we opted to send reminders after a week to ensure students knew these emails were being sent.

The second phase involved reaching out to students who had consented to participate

in the study but had not yet accepted the invitation to join the Slack workspace. This began during the second week of the study and was aimed at expediting the invitation process, although it came with some potential privacy risks. For these students, we manually sent an email containing an invitation link, similar to what we explained before that was set to expire after seven days. We hoped that students would see it easier to join the workspace.

3.1.8 Duration of the implementation

During the implementation stage of our study, we opted to simulate a methodology inspired by previous research [Menziez and Zarb, 2020]. As such, our implementation ran for the entire duration of the Fall 2022 semester, so we could gain a comprehensive understanding of the impact of our approach on the courses without any interruptions. However, as our experiment did not meet our expectations and the Fall semester also included winter holidays, we decided to expedite our data collection and interview process to minimize the loss of participants. It is important to note that our data collection process began before the experiment was fully finished. However, the implementation continued during this time. We did not view this as compromising since students had yet to interact on the platform up to that point, and we anticipated that they would not do so for the remainder of the semester

3.1.9 Data Collection Instrument

To gain insight into why our approach and implementation did not meet its initial goals, we conducted interviews with students who participated in our study. Our goal was to gather firsthand knowledge from students, understand the aspects of our study that did not work, and identify areas for improvement for future implementations. Additionally, we aimed to determine if the software we chose was inappropriate, if the selected courses were unsuitable for this approach, or if students had already established communication and collaboration channels through other means. By doing these interviews, we hoped to

better understand the issues and challenges that arose during the implementation and create design recommendations for future implementations and research.

When planning for these interviews, we aimed to recruit a representative sample from the pool of around 30 students who had signed up for the study. Hence, we decided that interviewing approximately 15 participants, or close to 50% would meet this criterion. However, we also kept in mind data saturation [Fusch and Ness, 2015]. If we found that the data collected from interviews was becoming repetitive, we could have reduced the number of interviews. However, since the implementation did not work as anticipated, we felt conducting as many interviews as necessary was important to fully understand the reasons behind the failure.

To ensure a comprehensive understanding of our implementation we aimed to interview at least one student from each of the four courses in which our study was implemented. Hence, we used a sampling approach that incorporated elements of *purposive*, *quota*, and *convenience* sampling. Purposive sampling was used to select students who met specific criteria and might provide different perspectives and understanding [Mason, 2017]. Additionally, we used quota sampling to ensure representation from all levels and majors, as we wanted an extensive perspective of the challenges plaguing our implementation [Robinson, 2014]. However, due to time constraints and limited sampling size, we relied on convenience sampling to proceed with all interviews regardless of other factors. Using this mixed sampling approach ensured we captured a broad range of insights and opinions from our study participants.

Our interview protocol consisted of 18 main questions, which were then supplemented by different questions (See Appendix). The creation of our interview protocol was inspired and based on prior research in the domain of CMC [Garcia et al., 2009]. Hence, these questions were designed to cover a range of topics, including communication needs, student interaction, other software used, and general perceptions about the implementation and why it failed. To ensure that the protocol effectively gathered the information we needed, we revised and refined it multiple times. We estimated that each interview would take around 45 to 60 minutes to complete, with the possibility of extending it further if the

student was willing to do so.

After having created the interview protocol, we initiated the recruitment process for participants from all four courses. We sent individual emails from a basic template (See Appendix) to potential participants, informing them about the purpose and duration of the study, as well as a small incentive for participation. The email also contained a Calendly link, which allowed them to schedule the interview at a date and time of their choosing. We divided the experiment into two stages to maximize the number of participants we could recruit. In the first stage, we sent out the recruiting email during the last week of October, and the after a week, we sent a reminder email to those who did not respond. Our efforts resulted in recruiting 12 participants, who were representative of all courses and levels (see Table 3.2 for details). As it was crucial for our study, this allowed us to recruit a variety of students.

Our interviews with the students followed a semi-structured approach, where we had a protocol to follow but also had some room for flexibility to explore emerging themes and issues that were mentioned throughout these. We believed this approach provided a better qualitative study experience than other interview methods [Pathak and Intrat, 2012]. All interviews were recorded with the participant's consent and lasted between 45 minutes to an hour, with some lasting longer if the student agreed. After completing all interviews, we used the Zoom auto-transcribing tool to create transcriptions. Although it is not a perfect tool, it helped us quickly transcribe and clean the data we analyzed after reviewing and correcting errors in the transcripts.

We used Thematic Analysis [Attride-Stirling, 2001, Braun and Clarke, 2006] to analyze the interviews and interpreted the data according to the research questions in our study [Creswell and Poth, 2016]. Rather than solely ordering themes based on their appearance in the data, we also considered their importance based on literature in the field. This allowed us to better understand why our approach did not meet its expectations and its implications for the domain of computer-mediated communication. We believe that this approach would enable us to comprehensively understand the issues at hand and provide valuable insights for future studies in this domain.

Participant	Level	Course
P1	Graduate	IST-520
P2	Graduate	IST-520
P3	Graduate	IST-520
P4	Undergraduate	IST-402
P5	Graduate	IST-520
P6	Undergraduate	ANSC 305 & 215
P7	Undergraduate	ANSC 305 & 215
P8	Graduate	IST-520
P9	Undergraduate	IST-402
P10	Undergraduate	IST-402
P11	Undergraduate	IST-402
P12	Graduate	IST-520

Table 3.2. Students Recruited

Chapter 4 |

Findings

4.1 Themes

During our interviews, we aimed to understand why our implementation did not meet its expectations and identify areas for improvement for future iterations. We identified major overarching themes, such as *Technological* and *Educational* challenges, *Motivational Affordances*, and *Recommendations*, each containing minor themes and considerations mentioned by students. Although we reached data saturation regarding themes, each student expressed their concerns and thoughts in unique ways, making it challenging to group all themes together.

4.1.1 Technological Challenges

4.1.1.1 The Relevance of Application Familiarity and Visual Appeal

During the interviews, the theme of familiarity and appearance emerged as a significant factor in students' adoption of real-time chat applications, such as Slack, with many citing the wide range of tools available to them, including Discord, MS Teams, Snapchat, GroupMe, Slack, and WhatsApp. Students saw this as a challenge in itself, as they had a myriad of options for communication outside of the classroom but lacked a common tool for this specific purpose.

It became clear that some students were more familiar with other chat tools, such

as Discord, and less familiar with Slack, which posed a challenge for its adoption. Furthermore, some students mentioned that they would only consider using Slack if their close friends or colleagues were already using it.

“If it’s just class stuff in general, then texting, or like discord or slack but usually discord, though. [...] I’m not a fan of slack Maybe because I’m not used to it.” -Alexander Whitmore

“I just think GroupMe is very well known within the academic community, and Slack is still like finding its way. So just I really think unfamiliar with the app is one of the reasons it wasn’t used.” - Alexandra Sinclair

The unfamiliarity with Slack among some students hindered its adoption and use. However, it was evident that the platform was not the issue, neither its features, rather it was the students’ lack of familiarity with it that intimidated them.

“Familiarity, I think if it was something people have already been using [...] You kind of know stuff about it [...] I think it would be better than introducing slack. I don’t think it’s slack itself. I think it’s just the introduction of the new app.” -Maxwell Hawthorne

When asked them about alternatives, students discussed their thoughts on other platforms such as GroupMe and Discord, where some acknowledged their usefulness despite personal dislike. In contrast, others praised their minimalist style and ease of use in connecting with others, ultimately highlighting the critical mass of these platforms as a driving factor in their widespread adoption and use.

“Personally I hate GroupMe, because it’s very slow and laggy [...] I don’t hate the idea of it. I just hate the app design because it’s very laggy.” -Amelia Kensington

“GroupMe for sure, I think that would be perfect. So what I said before, it’s a lot more informal. It’s something that a lot of people already use. There can

sort of be different permissions and ownership and roles that are assigned to multiple people, and I feel like it's a lot more sort of customizable.” - Samuel Kensington

This sub-theme reveals that our students gravitated towards alternative platforms due to their familiarity and attractive visual designs. However, as we delve deeper into our research, we will discover that this abundance of options poses a challenge for students, creating a dilemma of choice.

4.1.1.2 Discord Preference Over Slack

During our interviews, it soon became clear that Discord was a widely-used and popular alternative to Slack. One sub-theme that emerged under this topic was the prevalence of Discord as a preferred alternative to Slack. Many students cited its superior features, availability, and familiarity due to their use of it outside of the classroom. From the students' perspective, what sets Discord apart from other platforms like GroupMe is its widespread use within multiple domains as it hosts a variety of communities such as gaming, sports, and academia, making it a more appealing and accessible option for students. Additionally, the gaming aspect of Discord was noted as a particularly attractive feature among students.

“I think discord has like a really nice gaming appeal, and that's kind of like one of my hobbies So that's one reason why. You know I keep my gaming friends there as well as my work, friends, but like my acquaintances, so I can have everything in one place with discord.” -Alexander Whitmore

“ It's easier to find other people that also have the same interest or the same questions [...] So you'll see other people that are entering, and you can immediately start talking to one another [...]You'll see them pop up in other channels like if they're posting questions or asking for advice. Then I think it's easier to just find and connect with people” -Isabella Harrington

As we advanced in our research and conducted interviews, we made a notable observation regarding the significance attributed by certain students to Discord and its extensive adoption within academic circles. However, as we delved deeper, we also recognized certain limitations associated with Discord, as some students pointed out that the platform may appear too informal for academic use.

4.1.1.3 Advantages of Alternative Applications.

Further, during our interviews, we discovered a sub-theme related to the advantages that students found in using other apps instead of Slack. While there was no clear consensus among the students, we noticed that some preferred the simplicity of Discord for managing different groups and communities, while others appreciated the immediacy of Snapchat, where everything could be seen on one screen without having to tinkle with the platform.

“Discord seems more casual and more for like community building and like on the spectrum. So discord would be the most casual and community based.”

- Isabella Harrington

“I think it’s easier, I think discord is easier to manage, maybe just because I use discord more, but definitely Discord and Teams. I don’t really like Teams, but I think I would prefer it to slack.” -Alexander Whitmore

“I don’t know I feel like Snapchat is just the very instant, you can see, when people are typing. I don’t know if that’s a I don’t know I if that’s a characteristic of Slack.” -Amelia Kensington

Students also highlighted the importance of being able to share documents easily through the platform, as well as having read receipts, which Slack currently lacks. The latter was especially meaningful because some students mentioned waiting and wondering whether the other person had read their message. To avoid waiting around for replies. This is especially relevant in the context of using CMC as a solution to the slow email communication with faculty and peers.

“Because instead of like waiting around like Oh, how they see my message like I don’t want to double text them. I don’t want to bother them or like, call them. But if I know they’ve seen it I be like, Oh, they’re working on it, and they’re thinking about it, and they’ll get back to me.” -Amelia Kensington

“We used discord instead of slack, because I remember Slack had an issue with the free version, it was some kind of limit to it [sharing files], that you couldn’t access with the free version. So we switched to discord.” -Alexandra Sinclair

Also, as we discovered, there were some concerns regarding the file-sharing capabilities of Slack, which made students wary of the platform and ultimately limited the adoption of the platform.

4.1.1.4 Application Perceived Appeal

One recurring sub-theme was the idea of *Perceived Appearance*. Surprisingly, several students expressed that they refrained from using Slack to ask questions or socialize because they perceived the platform as too formal and not conducive to a friendly interaction. Additionally, some students felt that discussing academic matters such as assignments and readings through a real-time chat application such as Slack was inappropriate.

“Yeah, that’s what I perceived from that Slack channel [...] I think it’s it’s not appropriate to just comment how long the readings are, how difficult the topic. I don’t think it’s a good channel to just have private talk.” -Benjamin Montgomery

“I would say that because slack is more here towards professionals, you’re gonna interact in a more professional way, and it just feels more business casual, whereas GroupMe it’s very much like you talk about whatever. It’s a very relaxed way of communication.” -Penelope Beaumont

Another observation by students was that since Slack was designed for more professional settings, many of its features, although extensive, would not be useful to students or remain unused. Moreover, the platform's professional appearance could potentially blur the boundary between their academic and personal lives.

“Yeah, that’s what I think slack is more valuable in professional settings, because otherwise half of its features are just unused. I would not want to use this things that I use for professional reasons as the things I’m using for my social life as well.” -Alexandra Sinclair

However, it is worth noting that not all students had the same perception of Slack. Some students pointed out that other apps, such as GroupMe and Discord, faced similar issues. While Discord's gaming and community-oriented features were appealing to some, they also made other students hesitant to use it for academic purposes, as it could be distracting. In the case of GroupMe, although its ability to invite people and create groups was mentioned as a significant benefit, it also created a challenge when it came to organizing those groups.

“But I know Discord usually associated with video games rather than academics. So personally, when I use Discord, I find a little distracting, because I can see like my friends playing game and stuff like that” -Alexander Whitmore

“Slack is kind of an unknown app and I know it’s mostly for business. I think the idea of just making a group chat, and being able to invite whoever you want is really easy on GroupMe. But I like Slack, individual conversations rather than just having like a million groupies with the same people in it for different topic. Which I just think is is much easier than having like the same group but large chats. I think I just like the organized aspect of slack rather than group me.” -Maxwell Hawthorne

Slack's appeal played an essential role in its adoption. As we saw during our interviews, students felt uncomfortable learning this new platform and associated it with more professional settings.

4.1.1.5 Accessibility

Another student highlight centered on the accessibility of Slack and other familiar tools. During the interviews, students expressed that they would have been more encouraged to interact if other, more accessible tools were utilized. Issues such as reluctance to download the app on their phones or desktops and not receiving message notifications were mentioned. Interestingly, students also pointed out that apps like GroupMe were more user-friendly, enabling them to share a link to join ad-hoc, providing the benefit of instantly joining and interacting with others, as well as viewing past messages.

“I’d say just easier access, in Discord. I just have it on my computer, but so Slack I don’t want to download it, so I have to go to the specific browser ”

-Alexander Whitmore

“Just because like it notifies your phone directly It’s a little bit more personal, I guess as compared to like If I were using a third party platform like slack or teams, It doesn’t always update on my phone. So I just like texting.”

-Penelope Beaumont

“I think it’s a lot more user intuitive [GroupMe]. With Slack I know there’s the channels, and there’s a lot of nested things and a lot of like the forums of communication are a lot more hidden in Slack, and I feel like GroupMe is just like popular, and they can be created faster, and they’re like sustained for a long time ” - Samuel Kensington

From other apps, such as GroupMe we also understood that it was easier for students to send around a sharing link so they could join in an ad-hoc manner. This also gave them a great benefit: once they joined instantly, they could start interacting with students and even see past messages. In these cases, the accessibility came more in the form of how easy it was to prompt or start a conversation. In this case, GroupMe was mentioned a few times as their go-to platform because it allowed for a more immediate 'drop-in' dynamic where once you had the link and entered the group, you could interact immediately.

Which arguably turns this into an issue of community building throughout these apps. Additionally, the presence of these apps moved students away from using Slack, especially when other resources such as Discord or WhatsApp are more at hand.

“I would say, just like the ease of use, and like the convenience I would say, I think group me is a lot easier to use because you just go right in the chat, and just say whatever you want to say, you can put your little pictures, or like the name, or whatever. So you aren’t, confusing anything, and I think it’s a lot easier to navigate, and I’m somebody that’s very busy, like almost all the time, and very sort of high stress. So anything that is easy for me to use is something that I am a fan.” -Samuel Kensington

“I think GroupMe has probably been the best thing for all my communication in college so far. We all go on there to communicate with other students, and just kind of networks and clubs and stuff like that. So I think that’s the basis for GroupMe.” -William Worthington

In terms of accessibility, students valued the ability to get to the app quickly and start interacting with others without having to wonder about the different groups, invitations and registering for apps. As Slack had a more cumbersome registering process, it ultimately proved detrimental to its adoption.

4.1.1.6 Absence of a Unified Tool

Beneath the surface of the issues and benefits of the various communication apps discussed, a fundamental problem hindered the adoption of a single tool for classroom communication. The main obstacle was the lack of a universal tool that could serve both academic and personal needs. While the abundance of real-time chat apps provided students with flexibility and autonomy when communicating with others, it also proved to be a deterrent when contemplating the adoption of a specific tool. Students mentioned how they often ended up with multiple apps on their phones by the end of the semester,

juggling them for different purposes, resulting in exhaustion and frustration. As a result, many found themselves discarding apps that did not fit their personal preferences.

“In Discord we had like math problems to talk about, and in Teams we had a project that we had to coordinate with. GoupMe is a little different, is usually just people complaining about the professor or the class.” - Alexander Whitmore

“I don’t really understand why we need like eighty thousand different applications for everything. If everything was there in one place like, for example, if Canvas actually had the subsection where, it’s a discussion, but it cannot be seen by the Professor, then that’s cool.” -Jonathan Harrington

Other times students noted that the absence of a centralized tool for communication hindered the natural development of class relationships, making interaction challenging, particularly at the beginning of the semester. This created a situation where some students gave up and decided to stick with individuals they already knew or those they were paired with at the beginning of the semester.

“We would be randomly paired with um group members, and we would have to like, take the initiative to reach out, even though we have no idea who each other like was so a lot of it was just really difficult. I tried to get in touch with people through canvas and like. So just it just got difficult sort of like we reach out to people. I just ended up sticking with the same group, because we ended up all having each other’s numbers, and it was easier to communicate that way because we all knew each other.” -Penelope Beaumont

“I would say a lot of people don’t have each other’s contact information because people’s, phone numbers and stuff are not on canvas listed or anything like that. Also sometimes it’s harder to coordinate things with other people and do them. That would be to just try to figure about yourself or like go to office hours or something like that.” -Samuel Kensington

“When you’re taking a bigger course a lot of times you don’t interact. It’s harder to connect with students because it’s not a smaller setting. So you don’t interact with people as often. So if you’re in a bigger course, it’d be more convenient to have an app that’s already there for you a way to communicate with students rather than you doing it yourself and going out and trying to find people.” -Penelope Beaumont

Despite these challenges posed by the lack of a centralized app, students were aware of the requirements and limitations a tool would need to meet. For instance, a third-year student highlighted the following when asked about their preferred tool for a CMC scenario such as the one we implemented in our study:

“I guess a different app has to be created, and that one would have to be pushed, and it would have to be set with the intention of providing enough value to a student that they would start using it, and then everything else would come from there” -William Worthington

Likewise, when questioned about the usefulness of a centralized tool, another student demonstrated a clear understanding of its potential value and how they would leverage it for their communication needs.

“I mean that would be like the best part right? It feels like so much effort when you switch across applications or switch across websites. So this feels like you focus more. You are going to talk about HCI and you have these discussion groups.[...] So, if you have any doubts you can just like back to that particular papers or materials put in that particular channel.”-Jonathan Harrington

While most students did not explicitly reference their status as international students, for some, it was evident that their previous experience with these tools varied from what was used at Penn State. As a result, adapting to the new tools proved to be challenging and, at times, frustrating, particularly when they needed to exchange information quickly.

“I am coming here from Hong Kong, and in Hong Kong we used Wechat and Whatsapp the most for communicating. When I came to Penn State there were a lot of students who didn’t even use Whatsapp. It was mostly either iMessage or GroupMe.[...] You know when you are quickly trying to exchange numbers with somebody or just send them a message it becomes a bit difficulty because you are just installing the application in the moment and then connecting with them in the application instead of just giving the the number or sending it through WhatsApp” - Alexandra Sinclair

Finally, we discovered that in the absence of a centralized tool for communication, students turned to using Canvas as a workaround. Although they acknowledged that this was not the optimal solution, they found it helpful as they believed that everyone in their course would check Canvas at some point, and it was a means of ensuring faculty members were accessible.

“But then if all of these are inactive, in that case it’s just canvas discussions, because at least the professor looks into if people are being active or not, so that’s like some supervision, and people actually try to put in more effort to kind of get a good impression from the professor. So, at least like worst case people will actually reach out to you if you post something on the discussions page on campus. ”-Jonathan Harrington

Throughout our interviews, we explored the technological challenges our experiment faced and students’ perception of these. We saw that one of the most significant challenges was the abundance of communication tools available to students, including popular options like GroupMe, WhatsApp, and Discord, as well as lesser-known platforms. This wide range of options made introducing a new tool for academic purposes difficult, even if the benefits were clear and students had a positive perception of the proposed platform. This aligns with the TAM, which posits that familiarity with technology is crucial to its adoption. Furthermore, accessibility and perceived appeal also played a role in the students’ adoption of Slack and other communication tools. Overall, these

findings highlight the need to consider the various technological challenges students can perceive when introducing new tools for computer-mediated communication in an academic setting.

4.1.2 Educational Challenges

4.1.2.1 The Role of Courses - Perceived Course Challenges: Student Experiences and Perspectives.

Students recognized that several factors related to their courses affected their interaction and their role in our experiment and CMC. During the interviews, they mentioned variables such as class content, class delivery type, and difficulty. In terms of class content, students considered it crucial for their communication needs. While opinions varied among students, they generally agreed that in traditional courses such as math and physics, communication was more open because there was more room for discussion and questions of the content and its teaching.

“The class content really depends. When I was in physics class when I was in math class there was a lot more interactions between pretty much everyone among students. But now, with these classes they are more like individual assignments, this is also not as interesting to talk about.” -Alexander Whitmore

Additionally, students highlighted the importance of connecting with individuals who shared similar interests as it facilitated the development of relationships. This was particularly relevant as some of the courses where our approach was implemented were core courses, meaning that students were required to take them regardless of their interests. This was significant in testing our assumptions because one of our ideas was introducing our approach in one of these courses.

“I think it’s mainly like class content, or if I guess it depends on like introduction, discussion board posts. If someone has similar hobbies to me, I might reach out to them or something.” -Alexander Whitmore

“It definitely affects it to an extent because I’d find people with similar interests. But a lot of the time I just start talking to people because I don’t get something”
-Elizabeth Kingsley

Similarly, having individuals in the same major or courses was also perceived as essential for developing connections. One student pointed out that having individuals with similar interests and being in the same major could significantly impact their motivation to interact with other students.

“It’s just easy to do with like within the major, because we already have those like groups established.” -Amelia Kensington

“There’s a few people, probably, I would say, like six or seven people that are in similar classes with me. So I’ll probably communicate like talking in person in class, and sometimes we’ll text about like work.” -Maxwell Hawthorne

4.1.2.1.1 Course Difficulty In addition to the significance of the course content and major, students also emphasized the impact of the difficulty of their classes on their initial motivation to interact and its role in our study. Similarly to their content, classes with more challenging material that demanded more effort were more likely to see student interaction. This was because students perceived the need to collaborate with their peers to solve questions, assist with assignments, and work together.

“So I was able to manage this course without asking much questions, and since the name of the chat room is 520 I feel like I cannot say anything that’s not related to this course.” -Benjamin Montgomery

“I just don’t think the class having like a difficult enough course load to need to talk to each other about it I mentioned something else.” -Amelia Kensington

“So if I didn’t understand something that’s kind of important for me to know I asked my friends in the class like, ‘how many words does this paper have to be again like? I can’t find it on canvas’, so it’s usually things that I can’t find immediately ” - Isabella Harrington

However, students noted that difficulty may only sometimes be a determining factor in promoting interaction and communication. While difficulty certainly plays a role, it is more about the *perception* that it will generate more interaction due to having more questions. Nonetheless, students acknowledged that some courses, despite being challenging, might not create a welcoming environment that encourages interaction and asking questions.

When probing a student about the difficulty and its impact on interaction in one of their classes where they did not interact, a student made the following remark:

“I’m not sure honestly. I think it was just that class, because usually, if it was a different class, and I didn’t understand something I would reach out. But I think it was just a class.” -Elizabeth Kingsley

While this was a common perception among students, we wondered if this was more an effort to rationalize their lack of interaction than their actual perception.

4.1.2.1.2 Size Apart from the course content and its difficulty level, students also perceived class size as a crucial factor in their efforts to interact and communicate with others via CMC. Initially, our study assumed that larger groups would be more challenging to manage and less likely to promote interaction due to people feeling more intimidated, whereas smaller courses would be more conducive to this type of interaction and easier to foster a sense of community. However, some students noted the importance of course size and believed that, based on their past experiences, larger classes could have benefited more from an approach like ours.

“Because when you’re taking a bigger course it’s harder to connect with students because it’s not a smaller setting. So you don’t interact with people as often. If you’re in a bigger course, it’d be more convenient to have an app that’s already there for you a way to communicate with students rather than you doing it yourself and going out and trying to find people.” - Penelope Beaumont

“If I was in maybe one of the larger biology classes [...] I think those larger classes definitely would have benefited. I have a lot of people who started group me when I was a freshman. I think if we had Slack it would be easier so people could have those interactions.” -Maxwell Hawthorne

Students perceived that class size played a role in their interaction. However, some problems we also saw throughout our work, such as being in the public eye or being judged by others, would remain or be amplified in bigger classes.

4.1.2.1.3 Class Structure Lastly, students also highlighted the perceived importance of the class structure in their interactions through CMC means, which is primarily about how the class or material was taught. Students noted that courses that were discussion-based, such as the graduate course where our study was implemented, did not necessarily leave much room for interaction or asking questions, as most of it would happen in class, and outside of class they would have to do readings with little room for additional discussion.

“Well, I think it forces you to communicate with other students, whereas if the class is more of just like a lecture, I’ve had this before, and I don’t really talk to people just because it’s more individual. When you have group work you end up speaking to more people and getting to know them. And you know, you have to communicate in order to get assignments done.” -Penelope Beaumont

Furthermore, we discovered that in certain classes, such as our IST420 class, when students were assigned to different groups, they tended to stick with their groups, for the duration of the course, relying on them for support and guidance when they had any questions or concerns.

“I don’t really think that this class... I think people just kind of like found their groups and like stuck with it. So if I ever had a question, I would just ask my group rather than going on to slack and asking” -Penelope Beaumont

It may seem logical to assume that online courses, particularly given the circumstances surrounding the COVID-19 pandemic, and the fact this work evolved out of it, would result in more interaction and greater use of CMC chats. However, students did not seem to agree with this notion. They mentioned that the only reason they would interact was when it was necessary to complete homework, otherwise, they would try to limit their interaction to a minimum.

“Probably not. Usually for remote classes, I find that they’re pretty individual. In my experience with remote classes the only times that I would ever interact with students is during discussion boards. I’ve ever actually like made like a friend, from like a a remote class and like, actually texted.” -Penelope Beaumont

“So basically I’m a very active participant in the class, so if it had been online, I think things would go down in the sense that people would not interact.” - Jonathan Harrington

4.1.2.1.4 Perceptions of CMC forums Following our interviews and analysis of the data collected on courses that would be appropriate for a CMC approach, we identified a common trend among all the students. While they had different opinions about our approach and their past experiences, most of them viewed CMC primarily as a means to ask each other questions and seek help with assignments. However, we observed very little indication that students would use chat to socialize, connect, and build friendships. Although that was not our primary objective, it is noteworthy to see how students did not entirely view our CMC approach as a means to socialize (thought some of them did). For example, a first-year Ph.D. student provided the following quote:

“Yeah, as I said, I think students, they don’t have many questions to ask each other and because how the work, the course was organized it was clear and straightforward and there was no confusion at all.” -Benjamin Montgomery

In fact, as we will explore in the following section, many students lacked interest in establishing connections with others either through CMC or in-person, as their courses did not provide sufficient incentives for them to do so. According to students, these incentives could come in many different forms, such as integration with their courses, class difficulty, as we have already seen, and barriers that prevent them from interacting.

4.1.2.2 The role of familiarity and rapport in student's engagement with their peers

The previous section leads us to the next point in our study, which is the role of familiarity and rapport among students, and how students' perceptions influenced our experiment. Most students emphasized that being familiar with other students facilitated communication, and having similar tools to conduct this communication helped establish their relationships. As we have previously seen in this study, familiarity and communication were enhanced, or at least made easier, when students belonged to the same major or department.

"It's definitely pretty easy, because we're all in the same classes together [...] we're all in the same year. It's just been the same people which I find like really easy. So I was able to like make friends" -Amelia Kensington

"I think it's a little easier because I have lab mates who are also first years. I feel more comfortable asking them, since we're in similar classes. So I see them more often, and we have more of our relationship like friendship, because I see them so much, so it's a little easier for me to ask those questions."
-Isabella Harrington

Here students noted that having peers they were already familiar with would help them interact. However, as we saw throughout our interviews, student interaction was limited in most cases even outside of our experiment.

4.1.2.2.1 Lack of Motivation to Interact However, because we were interested in determining if this was the case for students who did not have prior connections, we probed students to understand why they did not interact with other students during our experiment or in other situations where they could have felt more comfortable. Surprisingly, we found that most students did not see a need to interact with others. In some cases, this was because they perceived the course to be relatively easy and did not require any assistance or the need to connect with other students. A common theme we have seen throughout this work that aligns with our previous findings on why students did not communicate with each other. For example, a first-year graduate student provided the following response when asked about their interaction in their class:

“Because the course is relatively easy I had less interaction regarding assignments. [...] Whereas in other courses there is often times, when we require one another for understanding or to clarify concepts or even doing an assignment.”

-Alexandra Sinclair

On the other hand, students mentioned that if they were to initiate communication with other students, they would have to be interested in knowing more about them to really open up for communicating. Otherwise, they would limit their interaction to asking coursework-related questions and leave it at that.

“Well, I probably wouldn’t ask them right off the back like for help. I’d probably ask them more questions like, What year are you? What’s your Major? What are you planning on doing in the future? But when it comes to like an academic connection. Usually I’ll just ask the question, and that’s it.”

-Maxwell Hawthorne

Similarly, as discussed in the previous section, other students did not see any value in establishing a rapport or relationship with other students, as they viewed themselves as able to navigate through the course independently.

“So if I have to communicate, if I have presentation, or if I have to write a proposal, or if I have to write like a shared report, that’s the only time that I reach out to my team members or other cohorts” -Benjamin Montgomery

“The main reason why I don’t [communicate] because I’m just there do the work, and then I have my next class so I’m trying to do my next class. And I just focus on the next thing.” -William Worthington

As we saw above, students noted that being familiar with other students could help them interact. However, this contrasts with the fact that some other students did not see a point in interacting with others.

4.1.2.2.2 Busy Schedules Among the students who did not interact in their courses, some mentioned that they were too busy to interact. This was either due to their heavy workloads or their schedules, which did not allow for much free time between courses. For these students, interacting with others felt more like a chore than something they really wanted to do.

“I was just thinking about too many other things in my life, and to to go out of my way to do that, it’s like why?” -William Worthington

“I’ll talk to the students in the beginning of this class mostly because I get there a lot earlier. Because I have back to back courses for the rest of the day. So I’ll be going, leave class go to another class, and then I don’t really get to talk to many other people there. I don’t have much time to do that.” -Maxwell Hawthorne

4.1.3 Barriers & Obstacles to Interaction

4.1.3.0.1 Lack of Incentives Having observed that students felt there was no real need to interact with each other, why was such a case? Both within the confines of our experiment and from prior experience, students noted that there were not any real

incentives to interact with other students. In this regard, the primary issue was the lack of any rewarding patterns that could encourage them to interact with their peers.

“Well, because there was nobody like prompting or any sort of instructions. Really, it was kind of up to us. Nobody really use it as much because you weren’t really sure what we wanted to do with it.” -Penelope Beaumont

“Unless somebody takes the initiative to make some type of group chat, or unless you’re already friends with or know the people in your class you don’t, really reach out to them” -Samuel Kensington

Others suggested that the reason for the lack of interaction was not just due to the absence of incentives but because students simply did not want to interact with each other. This aligns with our previous findings that students preferred interacting with people they were already familiar with rather than initiating new interactions.

“I don’t think you don’t need any benefits for interacting, if people genuinely wanted to interact they would interact as part of it. If people really wanted to. They would do stuff like this” -Jonathan Harrington

“So in [...] we have to speak and share our thoughts about meetings, even though I don’t want to. [...] So basically, if I, if I have a friend in [...] I would rather talk with her in five twenty class rather than trying to reach out to new students and have conversation with them.” - Benjamin Montgomery

Students also acknowledged the difficulty some might face in meeting new people or forming new groups, particularly when they already had a circle of friends they could rely on.

“I think the issue with trying to help adults communicate is because everyone kind of already has your group of friends.” -Alexander Whitmore

Finally, it is worth noting that some students wanted to interact but were not confident that what they had to say would be interesting enough for others to respond to.

“There was definitely times throughout the semester I was on slack, and I would see it, and I would just like check it out and like, I wouldn’t have thought of anything to say. I guess you know you just go into. I don’t know I didn’t have anything to add.” -William Worthington

These students helped see a common theme that was present throughout the interviews: the lack of incentives that students had to interact with each other. Regarding our experiment, students felt a lack of incentives to go the extra mile to interact with others.

4.1.3.0.2 Reluctance to Engage in Social Interaction From our interviews, we understood that students sometimes had the intention to interact with others, either through the Slack channel, in-person, or through other means. However, many of them mentioned that they were hesitant to do so due to feelings of embarrassment or a belief that their contributions would not be meaningful enough. Other factors that weighed on their decision to interact included concerns about how they would be perceived (e.g., immature) and potentially wasting others’ time. For example, a first year Masters student who identified themselves as socially awkward mentioned that the motive behind their lack of interaction was because they were afraid of being a waste of time for the other person.

“To be a hundred percent honest it’s because I felt like I would be wasting other people’s times if I said “Hello I’m [Alexander Whitmore], I’m interested in this this”. It’s like I had a feeling that people would say, you know, stop wasting my time.” -Alexander Whitmore

Another example is a third-year student who expressed concerns about being judged if they were the ones to initiate the conversation or start interacting. They mentioned that they did not want to come across as awkward or intrusive and were afraid that other students might not be interested in talking to them.

“Sometimes it’s a little hard to ask for help, sometimes you’re kind of worried about like being judged, especially with the new person.” -Maxwell Hawthorne

A third-year undergraduate student noted that they were hesitant to ask questions or interact with others because they didn't want to appear as if they were the only ones who didn't understand something. They feared being judged for being attentive or not being 'smart' enough.

“Because I didn't want to look like I was the only person that had that question like I didn't want to be seen as she wasn't paying attention, or oh, she didn't understand that that's weird. So that's why I'm a little more shy about posting. I just don't wanna be the person with the dumb question that's too dumb ”
-Isabella Harrington

Some students felt that the design of our implementation may have contributed to the issue of lack of interaction, as they were given too much freedom and were not sure how to approach them at the beginning and start interacting.

“I think it was pretty free for all, if I remember correctly, like we could do whatever we want. I was just too shy to be the person who started it all.”
-Isabella Harrington

“If there were only like three, or four people in the channel, and I say something, and if no one replied only three to four people know that I got it wrong. They're like thirty person in the channel. Everybody would think that oh, someone was brave enough to start the conversation, but she got ignored. I feel like I feel like thirty people would make fun of me if they see me in person.” -Benjamin Montgomery

Moreover, students faced difficulty initiating the first contact with their peers because the platform was designed with a 'free for all' approach, as pointed out by one of the students during the interviews. They felt that it was hard to make the initial move and start a conversation, as there were no clear guidelines or structures to help them navigate the implementation.

“I think for people that you don’t know, trying to communicate and like, establish that first basis of communication can be difficult. It can be hard to get things rolling. I would say just like the major issues would be just trying to reach that first contact.” -Penelope Beaumont

One student had a unique perspective on the barriers to interaction, as they expressed a strong desire to communicate with others but were hesitant due to concerns about academic integrity. This student explained that they were worried about the ease with which students could screenshot any communication and potentially report it as a violation of academic integrity. They believed that this concern was not related to the design of the experiment or the platform itself but rather to how Penn State managed these "outside" interactions.

“I wouldn’t want all that. I feel like Penn State It’s really weird with like academic integrity. I know some people got like kind of screwed over because, like simple group chats, they’re just communicating on assignments or labs. But that’s why I wouldn’t mess with it as much.” -Elizabeth Kingsley

This proved to be a substantial challenge for adoption and prompt student interaction. In many cases, students had some reservations about being the first to interact because they feared how they would be perceived and seen.

4.1.3.0.3 Anonymity During the interviews, we explored with students the possibility of an anonymous CMC approach to address some of the issues mentioned by students. However, we found that most students did not see this as a solution. In fact, they felt that anonymity would 'defeat' the purpose of the approach as it would be difficult to identify who was offering help or advice. Furthermore, some students mentioned that an anonymous approach would make it difficult to hold others accountable and create a sense of trust.

“I think I don’t want to give anonymity. Because we are just trying to get to know each other. So if I actually like, really like the person then I would want

to know who you know who this person is, and like further, try conversing. So a person's identity is very important.” -Jonathan Harrington

*“Honestly, I don't think it would have changed anything. I think, if anything, it would have made it a little bit like scarier, just because you don't know like when it's anonymous, if you can like, count on a person, whereas if I can attach like a name, then I can know that it's like that's a real person, and that's like they are in this class, and I can like, find them again, if need be.”
-Penelope Beaumont*

To some extent, anonymity was seen by other students as a potential solution to the issues of judgment and embarrassment in interacting with others through CMC. They believed being anonymous would make them feel more comfortable and less judged.

“If it's anonymous, I think it will be really helpful, because I don't have to worry about Professor judging me with this question.” -Benjamin Montgomery

“I think I would have liked that. I've actually thought about that for other classes where I have a lot of questions, and I'm kind of shy to ask. I would probably ask more questions. I would also assume that other people would ask more.” -Isabella Harrington

The issue of anonymity was perceived with mixed feelings by students, some of them citing the benefits of using it while others understood the negative side.

4.1.3.0.4 Integration and Involvement As we have seen, academic integration and involvement play a very important part in academic engagement [Pascarella and Terenzini, 1980]. Our findings suggest that the reason why students did not interact was due to a lack of integration and involvement. According to [Astin, 1984], involvement can be defined as a measure of the extent to which students are connected to their institution and to its academic and social life. The students in our study noted that their initial interest was high during the first weeks of the course. However, the lack of integration

and involvement with their courses and peers resulted in reduced interest over time. Additionally, students had specific expectations about their professors and classes, which affected their motivation to engage with the course and interact with others.

One of the graduate students highlighted how their interaction with other students in their discussion-based course dwindled over time.

“Well, actually, during presentation week, probably every day for like seven days through Microsoft teams, and then after that pretty much nothing.” - Alexander Whitmore

Additionally, some classes did not provide enough engagement or motivation for students to interact with each other. Students' expectations about their peers' level of engagement and motivation also discouraged them from communicating with others.

“I did at times [interact]. I feel like a lot of people didn't, because I feel like there wasn't really that much to sort of catalyze conversation. They're not very like passionate and motivated about it. So they weren't really propelled or inspired to do anything.” -Samuel Kensington

Some students pointed out that they needed structure and deadlines to feel engaged in the course. They emphasized how having clear deadlines, rubrics, and a Canvas page with all the necessary information was essential for their involvement in the course. Furthermore, students mentioned that when there were no deadlines or motivation to do the work, they did not feel compelled to interact with others. Since the engagement was minimal, students noted that there was not much to talk about and therefore no interaction occurred.

“I would say with this course, there is less structure, there are less deadlines, [...] it was kind of just vague. This is what you have to do. This is a paper, but we didn't get a rubric, or there is no page on canvas that details the requirements for it. But in other classes there is very detailed requirements for what we should be, including the rubric.” -Isabella Harrington

“I think a lot of other people weren’t compelled to do it, because there’s not that many deadlines in this course, so I feel like deadlines obviously motivate people to act. [...] So a lot of people that I know just like haven’t read haven’t done any of the work, and they just sort of skate by the class like there. I’m really like surprised with the lack of overall interest and effort in this class.”

-Samuel Kensington

In line with our earlier section on the importance of courses on interaction, we found that the way in which the classes were taught, either due to the nature of the material or the decisions of the faculty, had a significant impact on student involvement and their willingness to interact with others.

“The professor kind of makes me feel like I am the researcher, you know. Most of uh questions are very open-ended, and not very textbook oriented, but in the [COURSE] course. I feel like my brain is kind of a little dormant when it goes to [COURSE] class. So if all of these things are imbibed in your head, I would feel more active and more interested definitely.”

-Jonathan Harrington

“I think it makes them do less because you’re just writing a reaction to something [...] but almost no one responds to anyone. So it’s I don’t know, a lack of engagement So I think I think reading and then [writing a] reaction paper makes people interact less.”

-Alexander Whitmore

We found that integration and involvement played a significant role in students’ interaction and the perception of the Slack channel. As students were not fully immersed in their course content and peers, Slack was perceived in some cases as unnecessary.

4.1.3.0.5 Leadership As we heard the feedback from the students, we explored the idea of having an admin or a leadership figure within the chat who could promote communication and encourage student engagement. This approach was considered as

a potential solution to address the issue of lack of integration and involvement in the classroom. Ideally, this approach could give them the control and means to direct the group by themselves. However, when we asked students about the possibility of being an admin or having a leadership role within the Slack channel to promote communication and engagement, many were hesitant to take on the responsibility. Some felt it would be burdensome to have to monitor and police other students, while others worried that giving one or two students ownership of the channel would create chaos and favoritism. Overall, students did not see the admin role as a solution to the lack of integration and involvement and instead suggested that more structured and organized group activities outside of the chat could help build connections and engagement.

“I don’t think I would benefit, or would have done anything with that, because I didn’t know anyone else. But for this class I would just come in as a participant. I didn’t really have any ideas for how to bring people together, or what people would want to do” -Isabella Harrington

“I think no because if there’s too many people and have like the privileges, it can be chaotic you know.” -Samuel Kensington

In addition to the technological challenges, we learned through our interviews the different educational challenges that students perceived stopped them from engaging in communication, whether through our experiment or outside. Notable are the issues that stemmed from the classroom, such as the class size, difficulty, and method of delivery. At first sight, one could say that these issues are irreconcilable and that there is no easy fix to overcome these. However, as we learned through our interviews, and as we will see throughout this chapter, students did not feel the need to interact for a mixture of reasons, be it for lack of motivation and engagement or for the different obstacles and barriers they have to overcome to do so. As we did not give rewards during our experiment, no extrinsic motivators were provided; these obstacles and limitations proved bigger than their intrinsic motivation to connect and engage with each other.

4.1.4 Perceived Motivational Affordances

Despite our implementation not meeting our expectations of creating a sustainable approach to CMC, we still gained valuable insight into students' motivations for joining our study. By understanding their motivations, we hope to create better self-regulated approaches to CMC in the future. When we asked students about their motivations for participating in our study, we found that most recognized the potential usefulness of our CMC approach as a resource to aid them in their coursework. They viewed the platform as a means to ask questions, communicate with others, and read through other posts to see if their own questions had already been answered.

“I thought it was a good idea to have a Slack for the entire thing, even if I wasn't going to use it. I was really interested to see what other people would say, but no one used it.” -Alexander Whitmore

We quickly learned that students joined our study with the expectation that it would be a useful resource for their courses, allowing them to ask questions and communicate with others in case they encountered difficulties with their coursework. However, as we have seen, most of the courses where we implemented our approach did not provide many opportunities for interaction, as the difficulty was not a major issue for most students.

“Also because I didn't know what the class readings would be like. I thought, Oh, maybe it'll be helpful down the line. If it's like good, and it's active, then it's another resource for you to reach out to.” -Isabella Harrington

Additionally, some students saw the channel as a place where they could interact with others without fear of judgment or monitoring by their professors, providing a space for them to escape the traditional classroom environment. Interestingly this perception contrasts with other students as they were reluctant to interact by fear of being judged.

“I think it kind of provided a lot of value because it gave a medium for students to kind of connect. It was already like built for you to ask questions, and get to know each other.” -Penelope Beaumont

“I was thinking people are actually gonna be super active over there. Because the professor isn’t over there in this group I thought like we can have like more fun discussions, and little bit of judgments.” -Jonathan Harrington

Similarly, some students signed up for our study because they were aware of the challenges of establishing new relationships and communicating with other students in their courses. They believed that participating in the study could provide an additional avenue for communication and connection.

“I signed up to the experiment because I thought it was a good opportunity to improve communication. Because, communication is sort of very like class, dependent and fragmented in a lot of the courses, and it just sort of depends on like who, you know, going into the class a lot of the time.” -Samuel Kensington

While some of our assumptions were proved wrong as the Slack channel fell into disuse, students nonetheless had a positive perception of the experiment and the different affordances it could provide them.

4.1.4.1 Social Motivations

However, one of the most interesting reasons why students joined our experiment was to potentially make new friends or connect with others who shared similar interests. Even if at the end of the day it meant that they would only use the space to ask questions to each other.

“When I sent out to this experiment I thought this chat room was going to be really active, and it will help me to make friends, and it will maybe help me to know more about HCI area.” -Benjamin Montgomery

“I thought it would be a nice way to get to know other people like, because it was the first week of school, and I didn’t really knew people. I’d want to like meet other people, and for some kind of little community where we can ask

questions one another I thought that [Slack] would be a nice way to do that.”

- Isabella Harrington

“I ended up like seeing I could identified the students in the slack platform, and I could tell that they were also interested in communicating with other students.” -Jonathan Harrington

Students’ previous experiences with Slack played a role in their motivation to join the experiment, as their previous contact with Slack was positive and they viewed this as an opportunity to retake the opportunity and connect with others.

“So I’ve actually used slack in the past. It was actually very fun. It helped connect. The fact that I used it in the past was kind of a motivation to join the study I was also interested in meeting possibly new people in the class. See if I could get more connections with people who have more like interest.” -Maxwell Hawthorne

4.1.4.2 Perceived Value

Even though our experiment did not meet its expectations, we wanted to learn any perceived value the students put into this experiment prior to them joining. In addition, we also wanted to know if they could see themselves using a similar approach to CMC in their future courses. Students generally agreed that having a CMC approach in their classes could benefit them and welcomed the idea of implementing it in the future, again.

“I always like having like a chat with all the students in there for each class, just to talk about the class. Well, I usually don’t talk, but just reading about the thoughts about the class. But It would be good if moved to like a more casual setting.”-Alexander Whitmore

“It’s like the community building aspect, making friends. [...] But if there is an online space where I can get to know other people or start to form those connections then maybe I’ll be more motivated like, maybe we can like hang out. So I would still be open to participating.”-Isabella Harrington

Students mostly acknowledged and understood the potential benefits of a CMC approach like ours in classes with a large student body where they do not know each other well and interaction is scarce. They reiterated the usefulness of such an approach and welcomed the idea of its regular implementation after some improvements.

“It’s harder to connect with students because it’s not a smaller setting so you don’t interact with people as often. So if you’re in a bigger course, it’d be more convenient to have an app that’s already there for you a way to communicate with students rather than you doing it yourself and going out and trying to find people.” -Penelope Beaumont

But some were quick to note the issue of relying on voluntary participation instead of having the entire class included in the CMC approach.

“I don’t know if you can even do the but add the whole entire class. If you added, just more people I think there would have been much more interaction, because as long as one person starts talking like conversation will just continue.”
-Elizabeth Kingsley

Students also pointed out that the lack of continuity and consistency in implementing the CMC approach was a limitation. They felt that having it introduced in only one of their courses, without the option to use it in other courses, made it feel like a disconnected and jarring experience. They suggested that if this approach were to be implemented, it should be done across multiple courses and with a more permanent and consistent approach.

“I think if we had it for all courses it would be way more easier. I think I would like actually start using slack very, very commonly, like every day for all courses. I would be more proactive.” -Jonathan Harrington

Earlier in this chapter, we saw how the educational challenges impacted the interaction between students throughout this experiment. Here we see that students joined the

experiment eager to interact with each other and with the hopes of connecting and getting to know each other. Additionally, students perceived this experiment as an opportunity to help each other with questions and assignments. However, we know that was not the case, and this section reinforces the idea that this was caused by a complete lack of motivation to engage in any interaction throughout CMC means or in-person.

4.1.5 Improving the Approach: Students' Recommendations

In the final section of our interviews, we asked students for their recommendations on features that would be essential for a software application designed for CMC in an academic context. The suggestions were numerous and varied, with many different aspects and considerations brought up by the students. Some students suggested recommendations related to the management and distribution of the channel. They recommended that having a student create and moderate the channel would improve the experience, as it would align with a self-regulated approach.

“If, like a student created the slack and send it to everyone, it might have been used a little bit more.” -Alexander Whitmore

“As I mentioned earlier, like a moderator, might have made it a little bit better just to keep things active.” -Isabella Harrington

Another group of recommendations students gave us was related to the channel's visibility. Some students argued that the channel fell into disuse because people forgot it existed. They suggested adding email-like reminders, mid-semester notifications, or announcements during class to remind students that the channel was still active and available for use.

“I think that there could have been like maybe some check-ins or something like midpoint check in, you know, like saying, Ha! How are you feeling about the platform? Do you think your peers are engaging? So maybe, like some surveys or checkpoints in the middle?” -Samuel Kensington

One student pointed out that email notifications could be intimidating because they were notified when everyone joined the channel. They suggested making introductions mandatory so that everyone could get to know each other, with the consequence of being kicked out of the channel if someone decided not to do it.

“That’s because it was just like a complete wave of “this person joined, this person joined..” [...] So should I actually talk? Because if I start talking it might be like me playing it too hard. So I would feel like more discouraged. [...] maybe you should have something like a mandatory stuff where people introduce, else they cannot join the particular channel.” -Jonathan Harrington

Another suggested using gamification as a way to motivate students to interact more with the channel. However, their suggested approach was not to gamify the interaction itself but to gamify the classroom experience and use the channel to communicate.

“Like, I said, making it some type of gamified way to contribute the overall what’s going on in the class, as well as you know, dates of things that are due, or explaining something for a assignment, just something that’s so easy for the entire class to see from one person’s contribution” - William Worthington

“One way that would be definitely interesting is to incorporate the class into the overall structure, and allow for students to collectively understand what’s going on in the class. Giving the power to each student to contribute some type of thing that’s more than just typing a message into a channel.” -William Worthington

When asked about what they did wrong and how they would do things differently, students were very eager to share what they perceived could help such an approach. In this sense, recommendations were very varied, from incentives to gamification, icebreakers and more.

4.1.5.1 Incentives

One set of recommendations from students was related to in-class grade incentives. Although this may limit the self-regulated approach, as it would require some sort of moderation by an external grader or faculty member, we deem it important to consider. Students suggested that providing extra credit for interacting on the platform would incentivize them to use it more.

“I would even like add incentives by giving like some extra credit. I feel like that’d be a good way even if it’s just like a point like or two points on an exam like those help.” - Amelia Kensington

Students considered the idea of incentivizing interaction in the platform with extra credit, but others pointed out the challenge of making this incentivization meaningful. One solution proposed was to base the extra credit on the duration of interaction with the channel rather than just simple participation.

“I think that people would do people do like a lot of things for grades. I think that also not just joining the Channel you have to engage, like a certain amount of time on the Channel, to like, qualify for any reward.” -Samuel Kensington

Finally, another recommendation related to incentivization was to integrate the channel and its interaction into the course as a positive reward system that encourages students to connect with others. This would be a way to motivate students to interact without necessarily involving grades.

“It would have to be some type of in in a positively rewarding thing and doesn’t even have to be like a financial but just something that would connect people that is worth their time.” -William Worthington

To support the claim above by one of the students we found an example from another graduate student who gave a very good example to what the students above were referring to.

“I already use slack for one of my courses with my group members. We have to discuss in class, one of what we understood in class, and then one of us has to write it on the discussion group. But instead we send our own perspective on Slack, and then the person responsible for it that week combines everything and puts it on the discussion section.” -Alexandra Sinclair

4.1.5.2 Icebreakers and Prompts

During the discussion, the most common suggestion was the use of prompts and icebreaker exercises. Students believed that having prompts would help them break the initial barrier that prevented them from interacting with others on the platform. The researcher, instructor, or any other participant in the channel could provide these prompts.

“I think if a researcher or someone posted a prompt, I would reply to that prompt. I don’t know if others would, but I would for sure and maybe we’ll just see where that goes.” -Elizabeth Kingsley

“I think it would have been nice maybe is having like you are having somebody like start, give a prompt or start saying something first, rather than just leaving it up to the students. It’s like we won’t really take initiative unless somebody else makes that.” -Penelope Beaumont

Another recommendation that emerged was using prompts to introduce each other and share personal information such as hobbies. They felt that this activity would be more comfortable to do through text or CMC than in person, especially for those who may be shy.

Other student suggested on using prompts to introduce each other and include more personal things such as hobbies. This person argued in particular that while they might be shy to do it in class, it would be a very fun activity to do through text or CMC.

“Just to introduce yourself and your hobbies I don’t like doing it in front of other people in class. But it’s fun in text, because you can read it when you

want, and you can say it how you want um without coming off with a tone or something” -Alexander Whitmore

Also mentioned was the use of gamification to facilitate icebreakers and promote interaction. Students suggested that turning the icebreaker activity into a game could make it more engaging and help break the initial shyness. This approach was seen as a way to create a fun and low-pressure environment that would encourage students to get to know each other better.

“If there was a like a game like you know those iced breakers where you have to do a Bingo card with people that have different traits or different characteristics. So it’s easier for you to walk up to another person and be like, hey, what’s your name? Because I didn’t know why they joined, and I didn’t know what they were looking for when they join that community.” -Isabella Harrington

4.1.5.3 Alternative Platforms

In certain cases some students recommended using a different platform for the CMC approach altogether. They suggested using platforms they were more familiar with, such as GroupMe or WhatsApp. However, they did not consider other factors such as accessibility or appearance but focused more on their personal familiarity with the platform.

“GroupMe for sure, I think that would be perfect. It’s a lot more informal. It’s something that a lot of people already use. There can sort of be different permissions and ownership and roles that are assigned to multiple people, and I feel like it’s a lot more sort of customizable.” -Samuel Kensington

“I guess a different app has to be created, and that one would have to be pushed, and it would have to be set with the intention of providing enough value to a student that they would start using it.” -William Worthington

4.1.5.4 Moderators

Lastly, we received a recommendation for the addition of moderators during our interviews. While this would go against the self-regulated intention of our study, it was still an important suggestion made by students. However, modern technologies could solve this issue, as conversational bots, especially with the emergence of conversational AIs, could be integrated into these channels to act as moderators and provide resources to students, as we will explore further in this work. As some students noted these moderators could bring people in together and make the whole space more friendly for them. Additionally, they act as a resource because they can always answer questions.

“If I would change anything it would be people that are moderating, I think, when they are moderators it’s makes it so much easier to just talk because they are the most active, and if I do have questions, then I know that they’re there to like, answer it. moderators also, like they kind of pull people together like.” -Isabella Harrington

Another student suggested that having separate channels for moderation by TAs and faculty members could be a good idea to avoid any potential infringement on students’ privacy while they interact in the main channels. This would allow for monitoring and guidance without the feeling of being constantly watched by authority figures which was partially our purpose.

“You can have like a one channel with like, just the students on it, and one channel with the faculty and instructors, or like assistance maybe the TA. So that way if they see like any questions, they’re outside of like class time. It’s easier for them to address it.” -Samuel Kensington

“I think, just having somebody be like doing an introduction. If there is like a test coming, you know, having somebody like "Does anybody have questions?" or you know "How’s everything going?". ” -Penelope Beaumont

As we learned the different challenges that plagued our experiment and CMC in general, we could also understand directly from the students' perspective the different design changes and additions that could be implemented to an approach like ours and possibly to CMC to make it more appealing. Many of these recommendations revolved around creating a more engaging environment by adding prompts, icebreakers, and timely interactions through the channel to prompt students to interact. While giving students these interactions to increase engagement is sound, and should be pursued, if we intend to implement a self-regulated approach to CMC, we need to find ways to implement these recommendations and elements without incurring more work for faculty members.

4.2 Summary

In summary, our interview process and its analysis proved valuable in understanding the challenges and obstacles faced by our implementation and our experiment. As students voiced their perception about the challenges and obstacles, we noticed that from the technological sphere, our experiment faced a problem of adoption as many students were reluctant to use yet another tool provided to them when they were already familiar and accustomed to others that they were more proficient and had their communities, friends, and acquaintances there. From the educational sphere, students' perception was that their courses and the motivation to interact (or lack of) with others affected their acceptance of our experiment. However, an overarching issue stemmed from an overall lack of engagement with their coursework and peers, leading them to 'cruise' through the semester with a lack of interest. Additionally, students remarked on the lack of incentives to interact, inside and outside of our experiment, and their reluctance to interact with others for fear of being judged. Lastly, it is noticeable during our interviews that graduate students displayed more positive tendencies towards interaction with other students and the need to do so. Graduate students perceived the need for interaction as an useful resource as compared to undergraduate students, which would explain their initial eagerness to participate in the experiment. Nonetheless, students also voiced how

their initial perception of the experiment at the moment of volunteering was positive. Many joined with the idea of meeting new people or having an extra resource to ask questions and understand class material if needed. Having a better understanding of these obstacles to self-regulated CMC can help us to design a framework to overcome these. Specifically, understanding our challenges as both issues of adoption and engagement can better define a solution.

Chapter 5 |

Implications for Design

During our interviews, we identified two major groups of challenges and some barriers that impacted our implementation of self-regulated CMC: technological and educational. Technological challenges refer to issues related to the use of technology, regardless of whether it was present during our experiment or not. These issues include accessibility problems, students' preference for other applications over Slack, community building through different apps, and the absence of a unified tool that creates a lot of flexibility but does not allow for student coordination. Moreover, students mentioned how alternative applications such as Discord were perceived as a better option and the perception that the appearance of the app (whether it looked too professional) played a role in its adoption and usage. On the other hand, educational challenges refer to issues that arise from the educational sphere, such as the lack of incentives, integration, and motivation to interact with other students. We saw that their courses were perceived as paramount to their interaction, especially their size, and difficulty. Additionally, some students made clear that academic CMC channels were not appropriate for talking about anything besides school work, some did not see the advantages of interacting with others, and some others had a schedule that was too busy for them to engage with others as it was deemed too time-consuming. Lastly, students also made sure to voice the perceived barriers they encountered to interacting with each other. Among these, we found the lack of external (and internal) incentives to engage with each other, their integration, and involvement in their course work and community.

As such, we see these significant challenges as two major issues that affected our experiment. First, in the case of technological challenges, we perceived this majorly as an issue of adoption, as students needed to be more motivated to adopt the platform given to them. In the case of educational challenges, we argue this was an issue of motivation and engagement, or most appropriately, the lack thereof, as students were not motivated in any way, either intrinsically or extrinsically, to interact with each other. Even if our experiment did not meet our initial assumptions and expectations, we believe it can guide future research. Through our interviews, we identified the challenges and issues that students perceived, which can help us ideate an approach for self-regulated CMC that overcomes these obstacles and barriers. Drawing from modern literature and the information collected during our interviews, we can provide design suggestions to create an approach that would work better for future research. By addressing the challenges and issues we faced, we can improve the design of self-regulated CMC and increase the chances of success in future experiments.

5.1 When having too many options becomes an issue

At the beginning of our work, we emphasized the importance of the technology acceptance model (TAM) and how perceived usefulness and perceived ease of use are crucial in the adoption of new technologies [Davis, 1985]. We also argued that TAM and self-efficacy theory clearly explain who and why a new technology can be adopted [Bandura and Schunk, 1981]. Based on these tenets, we selected a tool for our experiment and hoped our students would adopt this technology easily and without much friction. This approach has been tested and accepted in other technologies and scenarios, as seen in the literature [Granić and Marangunić, 2019, Adetimirin, 2015]. Additionally, we believed that providing students with the workspace, channel, and tool would help overcome the cost-benefit paradigm [Beach and Mitchell, 1978, Johnson and Payne, 1985]. However, as we saw early on, our approach turned out differently than we initially expected.

During our interviews with students, they emphasized their familiarity and positive

perception of other platforms such as Discord, GroupMe, and WhatsApp. The perceived ease of use and usefulness of these tools was already positive for the students, in many cases more so than Slack. However, this was not perceived as an inherent issue with Slack itself, as many students liked the tool and were familiar with it. Instead, the abundance of options for CMC tools creates a challenging environment where no single platform is above another and every student is balancing between multiple tools based on different groups and hobbies. Therefore, we perceive this as an inherent issue of technology adoption, not because one tool is necessarily better than another but because the wide variety of tools available forces students to juggle between them regardless of their perceived usefulness and ease of use. The cost-benefit paradigm may have played a role in the adoption of Slack, as students ultimately chose the option they were more familiar with and accustomed to, even if they were initially motivated and familiar with Slack [Beach and Mitchell, 1978, Johnson and Payne, 1985].

5.1.1 Appropriating Learning Management Systems for self-regulated CMC

Understanding this as an adoption issue enables us to develop a framework that acknowledges the abundance of tools available to students. However, there is not a straightforward solution as students are already accustomed to using various platforms. While there are existing CMC platforms, and implementations with these [Sun et al., 2019], such as GroupMe and Discord, interviews showed that not all students are familiar or comfortable using them. Another possible approach would be to design a new platform that takes into account students' feedback and needs, and provides a unified space for all students. This platform could also be tailored towards academic purposes to align with previous research [LA, 2021] and increase its appeal to students [York et al., 2021]. However, this solution may face the same adoption challenges as we faced in our experiment with Slack, where familiarity with the platform played a key role. Ultimately, students may still resort to the tool they are most familiar with, highlighting the importance of addressing adoption challenges through other means.

One potential solution to the adoption issue in CMC could be to appropriate a platform that many college-level students are already familiar with. This is where Learning Management Systems come into play. Learning Management Systems (LMS) have been widely deployed in academic institutions and are mandatory in many of these. LMS have been shown to be effective platforms for sharing materials, submitting assignments, making class announcements, and facilitating communication among students [Lonn and Teasley, 2009]. Additionally, research has shown that students who are familiar with and use LMS in their coursework report higher levels of satisfaction with their courses [Kenny, 2003]. LMS platforms provide access to course content in real-time and offer opportunities for synchronous and asynchronous communication similar to real-time chats. From an adoption perspective, students already perceive LMS platforms as useful and easy to use [Goh et al., 2013]. One significant advantage of LMS is that students do not have to go through the hassle of downloading or registering for a new platform since LMS is already integrated into the school system.

5.1.2 Considering Students Needs

Considering the challenges and feedback provided by students during our interviews, we believe that using LMS for real-time CMC could be an optimal solution. However, to avoid the same adoption issues, it is essential also to consider the features and characteristics students mentioned they liked about other platforms. Fortunately, our interviews provided valuable insights into some of these characteristics. Our next step is to compare these features with modern LMS platforms. With numerous LMS options on the market [Kasim and Khalid, 2016], it is crucial to assess how some of the most common LMS platforms can meet the needs of students when used for CMC.

1. *Familiarity* During our interviews, it became clear that students preferred applications that they were already familiar with, even though Slack was known by most. This familiarity provided students with a sense of confidence in navigating and using these platforms. Furthermore, it can be inferred that by being familiar with

other platforms, students have already invested time in learning how the platform works, and potentially have a community of people within that platform.

As mentioned earlier, students are already familiar with LMS as these systems are widely used in most U.S. colleges. Therefore, the platform's familiarity would facilitate its adoption instead of causing hesitation or rejection among students.

2. *Accessibility* Students highlighted the issue of accessibility when using Slack. In particular, the fact that they had to access the platform through a web browser during their first use proved challenging for some. Additionally, some students mentioned having to set up notifications for the platform, which did not have default settings. We know that accessibility is a crucial factor not only for satisfaction but also for students' preference for one tool over another [Fearnley and Amora, 2020]. Most of the common LMS platforms such as Canvas, Moodle and Blackboard have mobile applications that students might be already familiar with, making them a potential solution to the accessibility issues that were mentioned during the interviews. Since students need to use their web browsers to interact with these platforms at a minimum, they are likely already familiar with their web browser integration. Moreover, research has shown that students are generally satisfied with using these types of platforms in their academic environments [Wilcox et al., 2016].
3. *Appearance* During the interviews, students expressed their preference for more casual-looking platforms such as Discord and GroupMe, as opposed to the more professional appearance of Slack. Some students found Slack's formal appearance less appealing and preferred a more relaxed-looking platform. It is well established that the perceived ease of use and usefulness of a platform can be influenced by its appearance [Davis, 1989, Huang et al., 2013]. Therefore it plays a significant role in the adoption of technology. However, students also expressed concerns that the casual appearance of platforms like Discord may be distracting and associated with gaming, which could interfere with their academic work.

The perception of Slack as being too professional and not suitable for academic

purposes was a significant concern raised by the students during our interviews. They also expressed the need to clearly distinguish between their personal and academic lives. These challenges led us to consider using LMS platforms for self-regulated CMC. LMS platforms are purpose-built for academic settings and are widely used in colleges across the US. Previous research has also shown that students perceive LMS as beneficial for their academic lives [Santiana et al., 2021]. By using an LMS platform, students can easily access course materials, submit assignments, and communicate with their peers in a familiar and academic-focused environment.

4. *Community Building* Several students mentioned Discord and how easy it was to create and engage in different communities, a characteristic Discord is renowned for [Johnson and Salter, 2022, Vladoiu and Constantinescu, 2020]. At the same time, Slack did not provide the same level of simplicity. The perception of community building is directly correlated with perceived usefulness and ease of use [Koch et al., 2011], making it an important characteristic in the adoption of new platforms and methods. Research has shown that students are more likely to engage in communication when they feel part of a community [Chou, 2001]. Therefore, it is essential to consider this aspect when designing a new platform or method for self-regulated CMC in academic settings.

While LMS platforms have been shown to facilitate community building through discussion boards [Camacho and Legare, 2021], though they may not be as effective as platforms that are specifically designed for community building, like Discord. However, adding real-time chats to LMS platforms could significantly enhance their ability to foster a sense of community and engagement. Real-time chats provide the immediacy and informality that students may crave in a community-building platform while also being integrated into the academic context of an LMS. This could allow for a smoother experience for students, as they would not have to move across multiple platforms to access course materials and engage with their peers.

Our interviews also revealed several minor features that students considered important to have in their real-time chat applications. Some of these features include read receipts, the ability to react to messages with emojis, and the ability to seamlessly manage multiple channels and communities. While these features may seem small, they can greatly impact the overall user experience, making the platform more user-friendly and efficient.

- **Emojis/Reactions:** Students noted the importance of being able to react to messages with emojis or similar features in real-time chat applications. Students see this a fun way to interact and express themselves while communicating with others. Additionally, the ability to see other users' reactions could improve the overall adoption of the platform.
- **Management:** Students mentioned that applications such as Discord and GroupMe made it easier to manage the different channels and groups they were involved in. This feature of easy management can be crucial for students who are a part of multiple groups and channels, and helps them keep track of conversations and information.
- **Read Receipts:** Lastly students noted that read receipts would be a helpful feature in real-time chat applications as it would let them know if their messages were read, saving them time from wondering. Additionally, some students mentioned that seeing when others were typing would give them confidence when communicating with other students.

Based on the characteristics and features students mentioned during the interviews, LMS platforms such as Canvas, Blackboard, and Moodle are excellent options for introducing a real-time chat for self-regulated CMC purposes. These platforms are already widely used and perceived as useful and helpful by students and have features that excel at sharing files, group management, and community building [Santiana et al., 2021]. Introducing a real-time chat integration to these platforms would provide a unified tool created specifically with academic purposes in mind, which would alleviate the issue of too many options.

However, while using LMS for self-regulated CMC would address the challenge of having too many tools to choose from, introducing real-time chats through integrations could potentially create a new hurdle for adoption. To ensure successful implementation, it is important to also consider engagement and motivation. By considering these factors, we can create a framework that aligns with students' needs while also addressing the challenges identified in our experiment.

5.2 Implications on design and engagement

In addition to the technological challenges, we identified educational challenges. Students perceived issues related to their courses that affected their need to interact with others, ask questions, and build rapport. They also reported a lack of incentives to interact with each other, limited integration and involvement with their coursework, and a general lack of motivation. While students perceived this as a problem caused by the nature of their courses, the overarching issue was a lack of engagement, resulting in a lack of interaction with their coursework and with others. This was evidenced by the fact that students were eager to join the experiment, and many did with the hopes of having an additional channel of communication and getting to know their peers but were not engaged enough with the platform or their material to interact with each other.

Through the lens of motivation and engagement, we can better suggest a functional framework to address the educational challenges identified in our study. Integration and involvement are crucial factors in driving motivation, which can be affected in many ways. While Self-Determination Theory (SDT) divides motivation into intrinsic and extrinsic, having a sense of belonging and being part of the social circle that encompasses the classroom is also an important component in driving motivation. Hence it is not just about having exciting and stimulating courses but also giving students the opportunity to feel this sense of belonging and social circle within their classes. This is where self-regulated CMC can be valuable, but our experiment showed that simply providing a platform for interaction was not enough to motivate and engage students. In our study,

we targeted intrinsic motivation, but as we realized halfway into our experiment, we saw that it was insufficient on its own.

To address the educational challenges we encountered in our experiment, we can design and think solutions that both draw from proven and modern literature as well as incorporating from the recommendations and insights given by our students during the interviews. This hybrid approach would help us better design to overcome these challenges and devise an approach that is a better fit for students and instructors alike. When we think about the educational challenges that our experiment faced, it is important to consider ways to motivate students through both intrinsic and extrinsic means. By looking at modern literature we can see that one potential solutions could be to incorporate gamification into our framework. Here is where the use of gamification could shine. Gamification is often described as providing a service that includes game-like features and avoidance to elicit changes in behavior [Hamari et al., 2014]. Hence gamification is often used to nudge individuals toward a desired state or behavior. Prior work on gamification has shown that gamification can affect both intrinsic and extrinsic motivation among students [Buckley and Doyle, 2016]. Previous research has also demonstrated that gamification can increase student engagement by making course material more engaging and providing additional incentives and motivation [da Rocha Seixas et al., 2016]. Gamification can be a powerful tool to keep students engaged and motivated. However, the success of gamification depends on its application and context [Guin et al., 2012], and we must carefully consider design considerations as we develop a self-regulated approach to CMC.

5.3 Gamified Self-Regulated CMC through LMS

Drawing from modern literature, and taking into consideration the recommendations from our students, we propose using LMS platforms for self-regulated CMC and gamification to improve engagement and motivation as a way to alleviate or solve some of the issues faced in our experiment. However, these two solutions are interdependent and must be

designed with one another in mind. Using LMS platforms for self-regulated CMC can make the platforms more accessible, but we need to find a way to maintain students' engagement and motivation to use them for continued and long-term use. Therefore, we suggest incorporating gamification elements into the real-time chat integration of LMS platforms. By doing so, we can increase students' engagement and motivation to use the platform while encouraging them to use the other features of LMS platforms that might otherwise go unused, as we know from prior literature [Ng et al., 2019, Ross, 2019]. In summary, our proposed framework for self-regulated CMC will need to consider adoption and engagement, using LMS and gamification, respectively.

5.3.1 Gamified Elements

In order to design a gamified approach to CMC using LMS platforms, it is important to consider design elements that can elicit changes in behavior and facilitate motivational affordances. Previous research has shown that gamification can increase motivation, user participation, and social interaction through community building, which were all important aspects highlighted by students during our experiment [Seaborn and Fels, 2015]. These affordances that are facilitated, also named motivational affordances [Hamari et al., 2014], are provided through what is called gamified elements [Sailer et al., 2014]. These gamified elements can be found throughout gamified literature [Werbach and Hunter, 2012, Kapp, 2012], and their primary function is to elicit these behavior changes and facilitate these motivational affordances. These can come in a wide variety and are often created based on the different needs [Morschheuser et al., 2017]. As we aim to design for adoption and engagement, our framework must use common gamified elements that students are familiar with while also eliciting engagement and motivation for the continued use of the platform. We refer to modern literature to identify such elements and propose their integration into our design.

- Points: The use of point systems in gamification has been extensively studied and widely used in gamification literature. Research has shown that point systems can have positive effects on engagement and motivation, as earning and accumulating

points can be seen as a way to gain recognition and a sense of accomplishment [Alsawaier, 2018, Kapp et al., 2014]. This can be particularly effective as an extrinsic reward system to motivate students. In terms of adoption, gamified point systems can also enhance the user experience and promote technology adoption by making it more meaningful and enjoyable for its users [Hamari et al., 2014].

- **Badges:** In addition to points, badges have been widely used in gamification to increase motivation and engagement. Research has shown that badge systems can trigger competitive motivation among students, leading to increased participation [Pirker et al., 2014]. Furthermore, badges have been used to encourage the use of self-regulation strategies such as time management techniques [Hakulinen and Auvinen, 2014]. Interestingly, badges have been found to affect student engagement even when they have no direct impact on grading, indicating that they can increase both intrinsic and extrinsic motivation.
- **Leaderboards:** Leaderboards have been found to enhance motivation and engagement by creating a sense of competition among students [Eickhoff et al., 2012]. This is due to the visual representation of students' progress and their ranking in comparison to others. Studies have also shown that leaderboards can serve as an incentive system and increase user contributions [Farzan et al., 2008]. Moreover, the use of leaderboards can also facilitate self-regulated responses such as goal-setting, as students aim to be at the top of the leaderboard [Landers et al., 2017].
- **Challenges & Quests:** Incorporating challenges and quests into a gamified approach can increase engagement, motivation, and technology adoption in computer-mediated communication environments. Studies have shown that these elements create a sense of achievement and progression among students, leading to prolonged use of the platforms where these are applied [Chen, 2007]. They can also foster self-regulation strategies, enhancing goal-setting strategies [Barata et al., 2013]. By providing students with a sense of achievement and progression, we can help them stay engaged and motivated on a prolonged basis, while also improving the

adoption of the platform.

These gamified elements have been proven to address the challenges of lack of engagement and motivation, and also help with technology adoption, which were significant issues during our experiment. Therefore, taking advantage of the unique qualities and benefits of these gamified elements is crucial as we build the design blocks for our framework. Additionally, since these elements have been shown to be effective, we can adapt them to meet our specific needs.

5.3.2 Gamifying for Adoption

To address the challenges of adoption and engagement, we need to consider the design implications of using LMS platforms for self-regulated CMC. As previously mentioned, this requires designing for both adoption and engagement, with each issue requiring its own unique approach to ensure the best outcome. By utilizing different gamification strategies, we can facilitate desired behaviors and encourage users to adopt and engage with the chat integration more easily. To gamify for adoption and ensure that students find these chat integrations easy to use and useful, we can use approaches similar to those used in academia and industry. The first step is to divide this approach to help students both familiarize themselves with the chat integration and ease them into its use without losing the motivation to do so. We suggest dividing this process into two stages - *Onboarding* and *Exploration* - to familiarize students with the chat integration, build a sense of competence and self-efficacy, and encourage them to explore the platform's features further.

5.3.2.0.1 Onboarding Onboarding is a crucial step in adopting and using new technologies, especially when the users are new to the tool. Onboarding has been used extensively both in academia and industry [Lochrie et al., 2016, Anglin et al., 2021], and it generally refers to the process of familiarizing individuals or users with a new process or software application [Renz et al., 2014]. It helps to familiarize individuals with a new process or software application, building a sense of competence and self-efficacy, which

are significant predictors of motivation and long-term engagement [Bandura, 1977, Desai et al., 2000]. Additionally, we are also looking at it from the lens of technology adoption; onboarding has also been seen to facilitate technology adoption [Nielsen, 1994], which is the most important factor in this stage. However, the onboarding process needs to be tailored to the specific needs of the students to provide these benefits. We propose an approach inspired by modern literature [Higgins, 2016, Renz et al., 2014] to help with onboarding by incorporating gamified elements, such as those described earlier in this chapter.

- **Tutorial:** As mentioned earlier, some students expressed a need for tutorials to address the adoption issue, particularly for those unfamiliar with Slack. Incorporating tutorials can provide an opportunity for students to familiarize themselves with this new tool. Prior research on tutorials has shown that they can increase users' confidence in using new tools and facilitate adoption by increasing motivation and satisfaction [Brar and van der Meij, 2017, Wiedenbeck and Zila, 1997]. Hence, providing tutorials can be a beneficial addition to the onboarding process in this gamified approach.

To facilitate motivation and engagement among students from the outset, we suggest a simple, interactive tutorial explaining the LMS chat's different features, including both basic and more complex functions. Upon completion of the tutorial, students would receive a completion badge and earn points toward the leaderboard. Such a tutorial could help students familiarize themselves with the chat integration and build a sense of competence and self-efficacy, which are important predictors of motivation and long-term engagement [Bandura, 1977, Desai et al., 2000].

- **Personalization:** Students mentioned personalization features and capabilities as essential elements in applications such as Discord and Snapchat, both of them having the option to create avatars. We can use this information to improve the adoption of the new chat integration within LMS by including different personalization features such as avatars and profile pictures that students could customize. Previous research

has shown that personalization features enhance user satisfaction, motivation, and continuous use [Komiak and Benbasat, 2006, Cheng et al., 2020, Mora et al., 2018]. Personalization can also aid in the learning process [Mayer et al., 2004, Yaros, 2012]. Therefore, incorporating personalization features into the LMS chat can help students feel more comfortable and familiar with its adoption.

Additional incentives can be offered to further motivate students to personalize their profiles, such as unlocking new avatar items or profile themes as they earn more points. Hence creating a sense of achievement and progress as they work towards unlocking new rewards. Moreover, displaying badges and rankings on their profiles can create a sense of social proof [Roethke et al., 2020], where students can see the accomplishments of their peers, further motivating them to engage with the platform. By incorporating personalization elements, we can create a more engaging and motivating experience for students while also helping them familiarize themselves with the chat integration in their LMS platform.

- **Conversation Starter:** During the interviews, students mentioned that they struggled to initiate conversations and be the first person to interact. Some of the reasons cited were the lack of incentives and motivation, heightened self-awareness, and fear of being judged by others. To address this issue, we propose a gamified approach to start a conversation that could help students overcome this initial barrier. Students could earn points towards their leaderboard or a badge for being a conversation starter, which would incentivize them to initiate conversations. Additionally, we could add prompts or icebreakers suggested by students to help them ease into the conversation and create a more friendly environment.

To provide a smooth onboarding experience, our approach involves introducing the chat integration in a clear and easily understandable way. This will include providing step-by-step instructions, tutorials, and interactive features allowing students to practice using the chat before engaging in conversations. The interactive features should be designed to provide a comfortable environment that allows students to familiarize themselves with

the chat integration without feeling overwhelmed or intimidated. By providing a seamless and engaging onboarding experience, we can increase students' likelihood of adopting the chat integration and using it effectively in their self-regulated CMC.

5.3.2.0.2 Exploration Much like onboarding, exploration is commonly used to help adopt new technologies or software applications. During this exploration stage, students would be encouraged to experiment with the different features the LMS chat offers. This could include features such as group chats, direct messaging, file sharing, and integrations with other tools. By allowing students to explore these features on their own, they can better understand the chat integration's capabilities and how it can be useful for their academic work. This approach has been shown to be effective in facilitating a better learning experience for individuals [Carroll et al., 1987]. Additionally, by allowing students to explore the features of the chat on their own, they can also discover new ways of using it that may not have been initially anticipated, leading to more innovative and creative uses of the technology.

- **Emojis:** Emojis have become a ubiquitous feature in modern CMC communication tools and have been shown to enhance communication [Manganari, 2021]. Therefore, it is important for students to be familiar with the implementation of emojis in an LMS chat. To gamify this aspect, students could be rewarded with badges or points for using emojis a set number of times, at least initially during the exploration stage. This would encourage the use of emojis in conversations, promoting a more expressive and engaging communication style.
- **File Sharing:** Our experiment revealed that some students needed to be made aware of the file-sharing capabilities of Slack, which might have hindered its adoption. Therefore, it is crucial to make students aware of the different features and capabilities of the LMS chat. To do this, we propose adding a gamified element that encourages students to share files and explore the different file-sharing options available on the platform. For instance, a badge or points could be awarded to students who share a certain number of files or use a specific file-sharing feature.

To increase students' engagement and motivation in using LMS chat integration, we proposed the implementation of the two gamified stages - onboarding and exploration. These stages enable students to become familiar with the tool without losing interest and motivation in its usage while tapping into their extrinsic motivations and sense of competency and providing feedback. Additionally, integrating these gamified elements onto an LMS chat integration would further enhance its functionalities and features, thus making it more appealing to students. Using these gamification techniques can create a more enjoyable and satisfying learning experience, leading to better academic outcomes.

5.3.3 Gamifying for Motivation and Engagement

In addition to designing for adoption, we also need to consider how we can design for engagement to ensure that students are motivated to use the LMS chat integration continually. To achieve this, we can draw from modern literature to adapt a design framework that meets both the student's needs and our goal of continuous use.

Recent literature has highlighted the impact of gamification in increasing motivation and engagement in educational settings. Adaptive gamification, a tailored gamified experience for the individual similar to player modeling, has shown promise in this regard [Lavoué et al., 2018, Charles et al., 2005]. However, while these approaches offer a high degree of personalization, they can be complex to design and implement, often requiring additional knowledge and assumptions about users. For example, recommender systems or machine learning algorithms may be necessary to create an effective adaptive gamification system [López and Tucker, 2018]. Despite these promising advancements, there is still a lack of comparison studies between adaptive and non-adaptive gamification in education [Hallifax et al., 2019], and extended implementation periods may be necessary to fully understand the effectiveness of adaptive gamification in practice.

It is important to note that gamification is not a one-size-fits-all solution for motivation and engagement, and its effectiveness can vary depending on the approach [Saleem et al., 2022]. While gamification is often seen as a fun experience, it's important to remember that the focus should be on making the experience itself fun, not just the gamification

aspect [Dale, 2014]. In light of this, we propose a framework for using gamification to keep students engaged and motivated in adopting a CMC approach for collaboration and self-regulated learning processes, rather than solely for their course work. To achieve this, we look to real-world examples of gamified *liminal spaces* and their success in motivating the continued use of a tool or platform.

Liminal spaces also referred to as threshold concept, is a term coined by anthropologist Victor Turner [Turner, 1998], and it was described as the time during which someone is going through a rite of passage. Modern interpretations of this concept argue that this is a space where someone is transformed or where someone acquires new knowledge [Meyer and Land, 2005]. This interpretation understands that during these spaces of 'in between,' a certain amount of learning is involved. Most recently, we have seen how technology has made use of these spaces in-between, these liminal spaces, to effectively create a sense of belonging and community building through its contextualization. Resorting to an example we might now be very familiar with, mobile applications have allowed their users to enter this space by interacting with their content and features [Farman, 2020]. This has been done by connecting the physical and digital worlds using features and strategies that combine online and offline interactions. Research suggests that creating applications that seamlessly integrate digital and physical experiences leads to more engaging, context-aware, and user-friendly environments [Licoppe, 2004].

In these liminal spaces, gamification has been utilized as a tool to effectively engage and motivate individuals. For instance, Pokemon Go utilized location-based quests and the interplay between the digital and physical space to foster social interaction and enhance user engagement [Alha et al., 2019]. Another example is the work by Monnier and Winter, where they gamified the liminal space between the library services and the writing center to engage students to self-regulate their well-being and learning [Monnier and Winters, 2022]. The common thread among these approaches is the use of gamification to make the in-between of these liminal spaces more meaningful and engaging, thereby keeping individuals motivated to continue with the proposed activity.

The use of liminal spaces in modern technology has become increasingly common, as

mobile applications and platforms often utilize these spaces to increase user engagement. Duolingo, a language learning platform, is a prime example of this trend, as it has become one of the most popular platforms of its kind in the world [Munday, 2017]. One reason for its success is its use of gamification to fill these liminal spaces. When users sign up for Duolingo, they are presented with a learning experience that is divided into increments of N minutes a day, with the largest increment being 20 minutes. This approach allows Duolingo to effectively tap into these liminal spaces in short segments, encouraging users to engage with the platform on a daily basis.

However, Duolingo did not reinvent the wheel when it comes to gamification. Instead, it uses proven gamification methods. It has an introduction phase that involves simple onboarding and exploration of the platform. The real gamification occurs in those daily N increments where a person earns XP, badges, and streaks through continuous engagement with the platform, in addition to the instant feedback that the platform provides. These approaches, especially the winning streaks and badges, have shown to increase learners' motivation and focus on completing their goals [Huynh and Iida, 2017]. Studies have shown that at an elementary level, it is as effective as regular face-to-face instruction, giving students the same self-efficacy [Rachels and Rockinson-Szapkiw, 2018, Bandura, 1977]. However, some debate is still on whether it offers a better experience than regular college-level courses. Duolingo's success can be seen in its status as the most popular platform for learning languages globally.

Hence, when implementing gamification, it's important to consider the gamified elements and how they fit into the context of the platform and the users. Simple gamified features can have the same benefits as more complex ones and often require fewer technological barriers (a known issue with gamification). We suggest keeping the gamified features simple for a CMC environment within an LMS platform and focusing on how they interact with CMC rather than their complexity. Here are some possible ways to add gamification features to an LMS platform for CMC:

- Participation Points and Badges: Points and badges can be awarded for actively participating in discussions, providing peer feedback or engaging in other forms of

interaction. Students can be reminded of the opportunity to award these points through simple notifications throughout the day to actively enter their liminal spaces much like we have seen with the previous example to effectively engage students. To further motivate students and affect their extrinsic motivation these achievements and points could be displayed in their LMS profile giving them a sense of accomplishment and self-efficacy.

- Discussion Leaderboard: The integration of leaderboards is a way to show students their contributions in a measured way through the points they have achieved. This would be done based on the quantity and quality of the contributions during their discussions. Like the example we discussed earlier, these would provide students with a sense of pride and motivation. Additionally, these leaderboards could be implemented consistently across semesters to provide a greater sense of pride and motivation among students.
- Timed Theme Challenges and Quests: Much like other examples, creating weekly or biweekly themes and Quests would help students stay engaged with their coursework. These quests and challenges could relate to their course material and require students to collaborate, research, or debate using the CMC tool available in Canvas. Completing these quests can earn students points or badges, which can be displayed in their profiles.
- Time-based or Frequency-based Incentives & Activities: A way to enter the students' liminal spaces would be by offering incentives for students who participate in online discussions or complete assignments on time. These time-based activities and incentives could lead to students engaging with the CMC tool throughout the day in small increments.

These features may appear simple and basic, but their significance lies in the application and environment in which they are implemented. As discussed earlier, modern mobile applications like Duolingo use liminal spaces - the spaces in-between - to keep users continuously engaged with their platform. The integration of these elements should

similarly enter students' liminal spaces to keep them engaged with the LMS platform, the CMC implementation, and their coursework. Rather than waiting for students to initiate interaction, a gamified approach to self-regulated CMC should actively seek and engage them through these spaces. This would help overcome the major issue of disengagement mentioned by students during the interviews and ensure continued use of the LMS platform.

As students are already accustomed to constantly being connected through their laptops and smartphones, a gamified approach to CMC within the LMS would help bridge the gap between their courses and the digital platforms they use to interact with course content. By connecting the physical and digital worlds, this framework would seamlessly integrate the two, creating a more engaging and interactive learning experience for students.

5.3.4 Leveraging Emergent Technologies

Our proposed framework offers a solution to the issues identified through our interviews with students and the review of relevant literature. Our experiment focused on implementing a self-regulated approach to CMC, where students take responsibility for its use and faculty workload is reduced. Our framework could facilitate this by using LMS platforms, where gamification can be incorporated in a standardized way. These gamified CMC activities can be designed similarly to modern curriculum activities in LMS platforms, with a basic template, and applied across different courses. This streamlined approach creates a consistent experience for different courses and students, facilitating the adoption of this CMC tool within the LMS.

However, more modern literature can give us insight into the use of emerging technologies that can further facilitate and ease the challenges faced by our experiment. Specially since our approach while it might require a one-time effort by faculty members, issues such as moderation, the need for weekly or timed prompts and quests, as well as icebreakers and other activities, might require the involvement of a third party. To facilitate our approach, we resort to modern literature to find possible solutions. Hence

we argue that we can make use of a new emerging technology that shows promising results: *conversational AI*. These technologies use state-of-the-art machine learning methods and natural language processing techniques to imitate human interaction, text inputs, and even speech. One such tool that has recently caused ripples throughout society is ChatGPT, which has been able to imitate human writing and even solve tests with never-before-seen accuracy. The power of these modern conversational AIs lies in their ability to act as live chats and their reasoning power, enabling them to provide tailored feedback and assistance to students in real time.

As modern as these technologies are, they have already been used in similar situations as live chats. Studies have shown that when used as a self-regulating tool for students, the groups that made use of these tools felt higher satisfaction and were more likely to recommend them to others [Broadbent and Lodge, 2021]. This technology has already disrupted much of the educational domain [Dwivedi et al., 2023]. We propose to use this technology as a tool to be implemented along with other self-regulated CMC tools within LMS for students to have access to a live chat, but also to moderate the content of the chat within the LMS and organize the different activities we outlined previously. In fact, previous studies have shown promising results in this domain as they tried to gamify its use [Fadhil and Villafiorita, 2017]. However, our goal is not to gamify the use of a chatbot but to use the chatbot to help moderate and deliver the gamified self-regulated CMC approach to these LMS. Although the literature is limited, at least in the domain of education, there are examples in which these chatbots have been used to monitor and deliver the gamified experience to their users. Some of these examples are Duolingo, CiboPoliBot [Fadhil and Villafiorita, 2017], and MoodleMoot Australia [González-González et al., 2023]. Some of the ways in which we foresee these tools helping our approach are as follows:

- Encouraging Participation: As discussed, gamification often involves awarding points, badges, or other rewards for completing tasks or demonstrating certain behaviors. Conversational AI can encourage learners to participate by providing real-time feedback on their progress and celebrating their achievements. Moreover,

it can enter the students' liminal spaces by actively encouraging participation during these times in between their courses and the time they are working on their respective courses. While not as complex as newer algorithms, there is precedent about its use in platforms such as Discord, some of them with substantial success [Duvvuri et al., 2022].

- **Gamification Integration:** The integration of these conversational AIs can seamlessly integrate game mechanics such as quests, challenges, and leaderboards within the LMS platform. It can help learners understand and navigate these game elements, ensuring they remain engaged and motivated. Additionally, as our framework suggests using liminal spaces, these technologies can effectively seek the students' participation and adjust the gamified approach ad-hoc.
- **Progress Tracking:** By monitoring learner progress, these AIs can provide regular updates on their performance and achievements, which can serve as a motivational tool for learners. Instructors can also use this data to identify areas where learners could need additional support. Additionally, it can provide personalized feedback to each learner, which could help making for a more interactive and better learning experience.
- **Social Interaction:** These technologies, conversational AIs specifically, can foster social interaction among learners by creating a sense of community and competition. It can facilitate discussions, encourage collaboration, and enable learners to share their achievements with their peers by creating prompts or introducing icebreakers, both recommendations that students suggested during our interviews.
- **Scalability:** As one of the significant issues of gamification, that is its difficulty to scale it up due to technological and social barriers [Saleem et al., 2022] conversational AI provides an excellent opportunity as they can easily manage interactions with a large number of users simultaneously, making it an efficient solution for facilitating gamified CMC in large-scale learning environments.

While the use of conversational AIs or chatbots is still in its infancy, they can prove to be an excellent resource to help monitor CMC or the MLS platforms and remove the need for external monitoring and management. Additionally, incorporating a conversational chatbot, such as CiboPoliBot, into our CMC approach on LMS platforms can be a promising way to manage these and implement the gamified activities outlined earlier in this chapter. While research on these emerging technologies in education is still in its early stages, their potential benefits and impacts are worth exploring, especially considering their disruptive impact.

5.4 Summary

In this section, we propose a few solutions to our experiment's challenges and obstacles based on the students' perceptions throughout our interview process and modern literature on these topics as we divided our challenges into two main themes, adoption and engagement. To ease the issues of adoption that we understood stemmed from a lack of universal tools and a lack of familiarity with current tools, we propose the integration of self-regulated CMC in LMS platforms, there facilitating adoption while providing students with a platform they are already familiar with and widely adopted throughout colleges. Additionally, we suggest using gamification elements to enable the adoption of these chats to make sure that students can familiarize themselves with its implementation. For engagement, we recommend using gamification by using liminal spaces to actively engage students while using more simple gamified elements to facilitate its scalability and implementation. Lastly, we suggest the addition of emerging technologies such as conversational AIs to this gamified approach as we believe it can facilitate its implementation while also helping with community building. These solutions were created by using both insights from our interviews and modern literature on gamification, self-regulation and CMC, as a way to create an optimized solution to the challenges our experiment faced.

Chapter 6 |

Discussion and Conclusion

6.1 Discussion

We started our experiment in self-regulated CMC to understand how these approaches could affect student engagement, motivation, overall classroom performance, and interaction. However, as some of our assumptions were proved wrong, and our experiment and implementation failed to be adopted and used by the students, we shifted our motivations to fully understand the different challenges that our experiment suffered from. Consequently, we designed two new research questions that guided our work throughout the rest of the project to understand these challenges and create design recommendations based on these. Thus we sought to answer the following questions:

6.1.1 Technological and Educational Challenges

- *How does modern technologies, tools and educational challenges affect students' approach to self-regulated CMC?*

To do so, we conducted interviews with students to understand and assess the different challenges and hindrances that our experiment, and students, faced with our approach to self-regulated CMC. Through these interviews, we were able to unpack the different perceptions and challenges that our implementation had from the student's point of view. Based on our findings, we grouped these between technological and educational

challenges and the motivational affordances that students perceived our approach could have granted them.

In our aim to understand why our implementation one of the first things we noticed were the technological challenges; these challenges arose from various reasons but mainly stemmed due to technological impediments that other platforms or the perception of Slack had on its adoption. Of the initial issues we found and noticed was how students' familiarity with the tools presented played a role in their adoption. Although Slack, the platform used in our study, is a widely used and popular communication in professional settings, our interviews revealed that a lack of familiarity with it hindered the students' ability to use it for self-regulated CMC. In addition, this unfamiliarity additionally contributed to the student's reluctance to communicate with each other, thus undermining its effectiveness and its adoption further.

Another issue we found throughout these interviews was the absence of unified set of tools to communicate, which often led to inconsistencies in the way that students communicated with each other. We often heard in our interviews how students juggled between different platforms and sometimes just relied on emails or face-to-face communication because of this. As students see themselves using multiple platforms, it also becomes difficult for them to keep track of one specific tool or find the most appropriate tool for all cases. Arguably this creates a challenging situation for students as they cannot establish clear expectations for communication, which can also lead to decreased engagement and motivation to interact as they become hesitant to reach out to their peers [Aldhafeeri and Alotaibi, 2022, Cunha Jr et al., 2016]. We discovered that our implementation, even if your choice of the tool was somewhat appropriate, gave students another platform to worry about, which affected their motivation to engage through our implementation. Thus, we addressed this issue by suggesting the implantation of a single comprehensive platform that all students are familiar with.

Furthermore, we learned that the perception of Slack and its appeal played a role on the adoption of Slack and its use. Students, even those familiar with the platform, perceived that Slack was more suited for a professional environment, rather than an

academic one, opposite to previous research [Menzies and Zarb, 2020]. This led students to feel more hesitant about its adoption, leading them back to the platforms or methods of communication they felt most comfortable with. Additionally, for some students the issue was not only that Slack looked too professional, but also it was not as engaging, as a platform, as the ones that students were familiar with, for example Discord. Thus even if students entered the experiment motivated to use the platform, the moment they did not see its appeal became unwilling to invest any time and effort in learning or using the platform. Similarly to the issue of prior issue, our suggestion to this challenge was to appropriate LMS platforms for the purpose of self-regulated CMC, as students not only already have an understanding of these, but also familiarity, and many are comfortable with them [Kenny, 2003].

We also learned how the accessibility and preferences of certain platforms were seen as better than Slack's, especially in community-building cases and inviting new members to the channels. Regarding this platform, Discord and GroupMe were seen as the most prominent contenders as both platforms feel more organic in managing their communities and inviting other students. Additionally, platforms such as Snapchat were appreciated due to their immediacy in sending and receiving messages. While there is no specific solution to an issue such as accessibility, as each student will have different preferences, providing students with a platform they are already familiar with, such as LMS, can give through its adoption issues stemming from accessibility. Additionally, real-time chat integrations for LMS platforms are very varied, which adds to the different possibilities.

Moreover, our failed experiment also revealed that students' overall lack of motivation and engagement through their courses, which was caused by a lack of involvement and integration, also played a crucial role in the adoption of our approach. These low levels of motivation and engagement significantly impacted the students' willingness to engage with their peers. As literature has shown [Hu and Li, 2017], when students are not motivated or engaged, they are less likely to participate in discussions, seek feedback from peers, and collaborate. Moreover, our experiment was no different, even if students initially showed clear interest in it. Hence, the potential benefits of self-regulated CMC

were left unrealized as students failed to adopt our approach.

In addition, the student's belief that they did not need to create rapport with their peers further led to a lack of communication in the platform as they would see themselves as less likely to initiate and participate in meaningful discussions for fear of being singled out. Moreover, we saw that this lack of rapport and their belief that it was not needed led to an increased lack of trust. They then became more hesitant to share their thoughts, or seek help, for fear of any potential judgment and criticism. This belief that rapport was unnecessary also hindered their sense of belonging and community, as we saw through some of our interviews, they felt they were enrolled in a course but did not feel part of it. As literature shows, rapport is often essential for creating supportive and collaborative learning environments in educational settings, which generally leads to better student outcomes both socially and academically [Thakur et al., 2019, Hannah, 2013]. Also, having this sense of community and safety can foster environments where students feel more comfortable sharing their views and beliefs, in turn creating richer discussions and effective learning.

We also saw how the absence of incentives affected their motivation to interact through our self-regulated approach to CMC. Without any clear incentives, be it in the form of grades or otherwise, students did not feel entirely compelled to interact with each other. While our approach relied on intrinsic motivation, adding external motivators encouraging students to interact and create rapport can help them adopt and continuously use our approach. Lastly, we saw how students' integration and involvement affect their need and motivation to interact with each other. When creating an approach like ours, the platform to be used should help with this by integrating it as part of the course content.

In summary, our experiment highlights the importance of addressing technological and educational challenges and barriers when implementing a self-regulated approach to CMC. Future research should consider these factors and implement contingencies, such as the ones proposed here, in future design iterations.

6.1.2 Informing Design for Self-regulated CMC

- *How can the study these challenges inform the design of new tools for self-regulated CMC?*

During our experiment exploring a self-regulated approach to computer-mediated communication using Slack with college-level students, we identified two main challenges, Technological and Educational. Our analysis revealed that our experiment faced challenges because of platform unfamiliarity, excess of platforms students have to choose from, complexity, and overall lack of engagement and motivation to interact and engage with each other. To address these, we analyzed their root causes and subsequently designed a gamified approach for self-regulated CMC that leverages student's familiarity with LMS, platforms that students typically perceive as relevant to their academic experience [Kenny, 2003]. By leveraging a familiar environment, we hope to facilitate a smoother transition and adoption of the new communication tool, increasing the likelihood of adoption.

Furthermore, we designed a two-stage gamified approach by using these LMS platforms to facilitate adoption. We specifically focused on minimizing the learning curve by suggesting the use of clear instructions, tutorials, and onboard experiences to help students familiarize themselves with the platform's features and functions, encouraging further adoption. Regarding the issue of engagement and motivation, our work highlighted the importance of integration and involvement with their coursework as well as the sense of community and the need to help students create rapport and incentives. To address these, we proposed incorporating gamified elements within the real-time chat application on LMS. Some of these gamified elements, such as leaderboards, badges, and points, help students create a sense of progress, and accomplishment while at the same time leveraging through these their extrinsic motivation [Eickhoff et al., 2012, Landers et al., 2017]

Lastly, we posit that our proposed gamified approach to self-regulated CMC would benefit by using liminal spaces, the spaces in between, giving students a sense of connection between their course and their classes, helping bridge the gap between their real and

their digital world. By doing so, we aim to make our approach part of the student's learning experience aligning it with course objectives and providing opportunities for meaningful interaction around course topics, thereby creating a direct link between students' participation in the self-regulated CMC and their academic success.

To sum up, our analysis of the challenges faced in the initial experiment informed the design of a proposed gamified approach for self-regulated CMC that leverages LMS. By addressing platform adoption and enhancing engagement and motivation, we aim to create an effective learning environment that supports student success in self-regulated CMC. The insights derived from this analysis can serve as valuable guidance for educators and researchers seeking to develop innovative and effective tools for self-regulated CMC in the future.

6.2 Contributions and Strengths

Because we embarked on a research project to understand why our experiment failed and how we could use such information gathered through interviews to inform future research on the domain of self-regulated CMC, we were able to understand these directly from students. Even though there is prior research on self-regulated CMC and the different challenges these approaches face [Menziez and Zarb, 2020], our work directly answers these challenges from a failed implementation in which students were eager to use it but fell in abandonment. Our interviews with students allowed us to identify our experiment's challenges and how modern technologies and educational methodologies played a role in it.

Additionally, based on our findings, we proposed a solution to these challenges by using LMS platforms for self-regulated CMC with the addition of gamified elements. Based on our findings, we created this gamified approach considering issues such as adoption, course integration, and scalability. For adoption, we propose a two-stage onboarding process that focuses on making students familiar with the approach and gives them the control and agency to familiarize themselves with the platform. For

course integration, we proposed the use of liminal spaces to enter the space between their real world, where their courses are taking place, and their digital world, where these LMS platforms and their courses are generally managed, helping them see the direct link between their participation and academic success. Furthermore, as we designed the gamified framework, we focused on more simple approaches to this to help with scalability and adaptability, two known issues for gamified approaches in education [Saleem et al., 2022].

Therefore, our work contributes valuable insights to the growing body of research on self-regulated CMC and gamification in education. The proposed solution can inform the design and implementation of future interventions, helping educators and researchers create more effective learning environments that leverage modern technologies and pedagogical strategies. The strengths and contributions of our work lie in its ability to address the challenges of platform adoption and student engagement and motivation in self-regulated CMC. By proposing a gamified approach integrated with LMS, we aim to create a novel and effective solution that enhances students' learning experiences and offers valuable insights for future research and practice in the field of educational technology.

6.3 Limitations and Future Work

The present work provides valuable insight into the challenges self-regulated CMC faces in the educational domain. However, it is not without its limitations. First and foremost, we acknowledge that generalizing results from this dissertation might be problematic for several reasons. First, our sample population for data collection was limited to 12 participants. Additionally, as we conducted qualitative analysis (interviews), the possibility of making generalized claims can be problematic and should be made with caution. Future work should focus on obtaining a larger sample and include quantitative analysis in the equation. Moreover, as most of the contribution of this dissertation derives from qualitative, there is the risk of personal biases. As we created our interview

protocol to remove any possible biases carefully, we still have to consider the risks of biases encountered during its analysis. As only one researcher analyzed the interviews, we could not include intercoder agreement measure to ensure that coding was done without external bias and in consensus [Lombard et al., 2002].

Secondly, all students recruited were done so voluntarily, meaning that those who were interviewed might already have a natural bias (either negative or positive) towards CMC and our experiment. Moreover, the experiment also took place without any interaction from the instructor's side, who could have been an excellent resource to further encourage the interaction through the channel we created. In this sense, future work should also focus on a joint effort between researchers and faculty to make sure these implementations occur on a course-wide scale instead of limiting it to volunteers.

Lastly, most of the qualitative data obtained were based on actual perceptions from the students and not based on their interaction with our implementation. As such, generalization should be done keeping this in mind and being aware of it. Future work should aim to successfully implement a self-regulated CMC approach that further explores the limitations and challenges.

6.4 Conclusion

Our study aimed to investigate self-regulated CMC using Slack among college-level students. However, the experiment did not meet our initial assumptions and expectations, and we embarked on a project to understand its challenges. Throughout this work, we were able to reveal the two main challenges that prevented the successful implementation of our approach to self-regulated CMC: the adoption of the platform itself and an overall lack of engagement and motivation. Drawing from prior literature, we proposed a gamified approach for self-regulated CMC integrated with Learning Management Systems (LMS) to address these challenges. Through gamification, we expect students to feel more integrated and involved with their course, thus feeling an increased sense of engagement and motivation. Additionally, by using the LMS platforms, we tackle the issue of adoption

of our approach faced by providing a platform with which most college-level students are familiar and feel confident about their use. Our approach thus leverages the familiarity of LMS platforms to facilitate platform adoption and incorporates gamification elements to enhance student engagement and motivation. Furthermore, our approach aims to foster community and collaboration, seamlessly integrated with course content, and promote the development of essential skills, ultimately creating a more effective and supportive learning environment. Lastly, we propose using more modern and emergent technologies, such as conversational AIs, to help manage and moderate these platforms and implement some of the recommendations mentioned by students.

We believe our work contributes to the ever-growing body of research in self-regulated CMC and gamification in education and offers valuable insights for future research and practice in the field of educational technology. By addressing the challenges identified in our experiment, the proposed gamified approach can significantly improve students' learning experiences in self-regulated CMC contexts. Future studies should focus on implementing and evaluating this approach to assess its efficacy and further refine the model for use in a wide range of educational settings.

6.5 Positional Statement & Future Directions

From our research, we learned about the challenges and implications that arose from a self-regulated CMC implementation. However, it seems only normal to consider what we as researchers would change if we were to do this again and create a second experiment or implementation. What comes to mind first is the choice of the platform; as we have seen throughout our work, we would focus and pay more attention to the selection of the tool to be used for another experiment. Additionally, we would focus on the tool to be implemented and the process of registering for the platform and accessing and recruiting students. As we understand that might have also been an entry barrier, we would make the process seamless. Moreover, we would aim to cover bigger courses to test also if the results would be the same as some students perceived and pointed out. Lastly, while our

approach is intended to be self-regulated, we would implement, at minimum, a mandatory introduction or ice-breaking procedure to make sure that students feel comfortable with each other and are familiar. However, if we were to make certain assumptions regarding time and resources, we would definitely use LMS systems to integrate our chat within these classrooms.

As for the next steps, our work presented here can set the groundwork for future iterations by considering some of the challenges this experiment faced. One of the most important takeaways from our work is the understanding that applying gamification, could be a good solution to engage students in these sorts of environments. However, it needs to be done actively in a way that students feel compelled to engage and reminded that the platform exists there for them, and can be used at any given time. Hence future work should focus on exploring and testing a way to actively seek students' engagement throughout these CMC platforms in a way that is manageable for faculty members.

Appendix A |

Semi-Structured Interview Protocol

Hello! [name of the participant]. Thank you so much for signing up for the interview and having the time to meet with me! Today in this interview I will be asking questions about your personal experience, inside and outside of this experiment. Remember that I'm not concerned about your grades, or how you study or what you think about the class. Moreover, this conversation will be completely confidential between us two, and the data will be completely anonymized. The questions here will be related to the experiment, how you communicate with students (inside of this class, and also outside, I will be sure to clarify that), and your opinion on the different challenges that arise from these types of experiments. Hence, there are no right or wrong questions. As such, do you consent to be audio and video recorded? If you feel more comfortable you are free to turn off your camera if you wish to do so. And again, please rest assured that this data will be kept confidential following Penn State regulations.

1. What is your year and major?
2. How many courses are you taking this semester?
3. In your experience, how easy or hard is it to reach out to other students, in your average class (outside of this experiment)?

- (a) Do you do that often in your courses?
 - (b) What are the major hurdles? Why?
 - (c) What is your preferred method of communication with them?
4. On average how often would you say you communicate with other students, from this class?
- (a) Would you communicate with them more often if it was easier?
 - (b) What are the major reasons why you don't communicate with other students?
 - (c) Do you think you would communicate more often if the class was online/remote?
5. How does this class differ from your other courses if anything, in terms of how it is being taught? For example, do you have weekly discussions? Do you have weekly assignments or essays?
6. Compared to other courses, how is your interaction (in this class) with other students any different?
- (a) Why do you think that's the case?
7. What are your communication needs in a course or class?
- (a) Are these being met? If so, how does this class compare to other classes?
 - (b) How does your communication differ between faculty and students? Why?
8. How are your communication needs with other students met? How does this class compare to other classes?
9. What led you to sign up to this experiment? What was your motivation? Why? (Do you think you could make friends, or get to know other students?)
- (a) What was of value to you in this experiment? Why?

- (b) Do you think that this experiment could have helped you get to know your peers more?
10. How familiar are you with Slack? Have you used it before?
- (a) Did you know how to use it prior to the experiment?
 - (b) Have you used it in any other courses or in other aspects of your life?
 - (c) Did you think Slack could provide any value to you? Why?
11. Do you use other alternatives over Slack (either in your private or professional life)? What benefits over Slack do you think it has?
12. How was your interaction with the platform, if any?
- (a) In your opinion why do you think there was a lack of interaction?
 - (b) If so, why were you not compelled to start out interacting with others by yourself?
 - (c) Why did you not feel incentivized to interact? How do you think you could have been incentivized to do so?
 - (d) Did you feel intimidated to post or ask questions in the chat? Why? If so, do you think being anonymous would help you? Why?
13. Looking at the platform; Would you have liked to have admin rights from the beginning?
- (a) Would you have liked to be in control of the public channels? Create them, delete them, add people etc.
 - (b) Would you have invited people from outside the course given the opportunity?
 - (c) In your opinion, what do you think the implementation needed for it to be more compelling, for you? (anonymous chat, provide grade rewards etc?)
14. How appropriate do you think this implementation was?

- (a) Do you think other courses could have benefited more from this?
 - (b) Would you like to see this implementation in other courses? Why?
 - (c) Is there anything you would change about the way this experiment was implemented? What changes would you like to see if given the opportunity?
 - (d) Do you think an online/remote (or hybrid) course would be a better option than in-person for this implementation?
15. How is your relationship with the other students (from this class)?
- (a) How do you think it affected how you interacted with them?
 - (b) How did your interaction changed from remote/online to in-person?
16. If given another opportunity, but using a different platform, would you consider volunteering to the experiment again? If so, why?
- (a) What benefits could another platform have over Slack?
 - (b) What features do you think are important in a platform like Slack, or Discord? Why? What are those features for?
 - (c) In your opinion, what changes would you like to see to make this experience better? Would you add anonymous chats, or give admin rights from the beginning?
17. Have you used another platform that is not Slack, with other students from other classes (Such as GroupMe, Whatsapp)?
- (a) If so, how was your interaction there?
 - (b) Why do you think it differs from the experiment?
 - (c) What benefits/features does that platform have over Slack?

Appendix B |

Recruitment Message

In this study we are investigating the use of modern messaging platforms to help both students and faculty interact more meaningfully. We propose adapting Slack as a platform for continual interaction throughout a course. The novelty is that the Slack group will be self-regulated by YOU, students, that is to say, the Slack group will be yours to use and manage as you collectively see fit. Keep in mind that Penn State code of conduct applies to your Slack interactions, but within those bounds what you do is up to you. The idea is for you to adapt the Slack group to make your course experience better. The Slack group will contain three different channels that you can use to pose questions, share information, or just socialize. You will be invited to it through your PSU email. Whether you choose to participate or not is also up to you. There are no penalties or extra points. This is an optional course enrichment. Once our study (and the course) is finished, you will be asked to fill out a questionnaire about your personal experience. We hope to provide students with greater control and engagement in managing their own learning experience. If you decide to participate, please follow this link <https://redcap.ctsi.psu.edu/surveys/?s=PL3XKJDDNX8LF4TR> and complete the consent form found within. Once signed you will be added to the Slack channel and can begin interacting.

The first six participants will be rewarded a \$10 gift card each. All participants who sign up the first week will enter a raffle for a \$100 gift card. After that participants will enter a raffle for another \$100.

If you have any questions, please don't hesitate to contact us: gkr5144@psu.edu
Thank you!

Appendix C |

IRB Approval

This research was approved by The Pennsylvania State University Institutional Review Board (#19794).

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WORK EXPERIENCE

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PUBLICATIONS

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