How COVID-19 Changed the Way Students Experience Learning: A Blending of Remote and Conventional Education

An Interactive Qualifying Project
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Abstract

COVID-19 displaced 1.4 billion students worldwide. We surveyed and interviewed students from BGU and WPI to explore changes in the student educational experience during the pandemic and recommend improvements to conventional education based on lessons from it. Students expressed that asynchronous material provides flexibility, allowing them to self-tailor schedules and their educational experience. Students reported increased anxiety alongside decreased motivation and attentiveness for courses during the pandemic. Our primary recommendation is to increase the availability of supplementary asynchronous course materials.

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Executive Summary

The coronavirus (COVID-19) is a global pandemic that has disrupted the educational sector, forcing campuses to shut down and schools to move to an online delivery method for education with little preparation. Many post-secondary institutions introduced online educational systems, where students watch and participate in lectures. We explored student narratives and developed targeted recommendations for how the educational experience at technically oriented post-secondary schools could improve in response to educational and mental health issues that the COVID-19 pandemic uncovered.

Overview of Methods

Our objectives were to identify educational and mental health effects on students, elicit and collect stories from students about their experience in the COVID-19 pandemic, and finally compare the benefits and drawbacks of the pandemic educational experience with the conventional educational experience as perceived by students. To identify the educational and mental health effects on students, we used online surveys with multiple choice selections and open-ended responses coupled with remote interviews of volunteers from Worcester Polytechnic Institute (WPI) and Ben-Gurion University of the Negev (BGU). The surveys contained 26 questions with the option to volunteer for a remote interview, which typically lasted between 20 and 40 minutes. To elicit stories from respondents and interviewees we crafted questions that captured the student experience regarding their personal life and academic experience during the pandemic. We collected 302 survey responses (127 BGU, 175 WPI) and performed ten remote interviews (four BGU, six WPI).

We performed content analysis on the write-in text from the surveys and transcriptions of the interviews to deduce common themes and points of interest in the student responses. We deduced the common themes by assigning each quote a general meaning, called a code, and then organized each code into a theme. The key themes we used in the categorization of responses were mental health, physical health, time management and flexibility, benefits of online learning, and a new working environment.

Key Findings

We found students suffered from increased anxiety and decreased engagement, but that students also benefited from the changes in structure due to the pandemic. Through careful analysis of our survey and interview responses, we developed our themes regarding students' experience at WPI and BGU during the COVID-19 pandemic.

Online learning causes a lack of student engagement. At both WPI and BGU, we found that 66% of students experienced lower levels of academic motivation. Both WPI and BGU students reported a lower level of attentiveness to their academics but reported only a slight drop in self-perceived performance compared to the Fall 2019 semester. We attribute these results to a lack of engagement – when faced with online learning, students get distracted or overwhelmed by real-world interferences or their workload respectively and tend to lose interest in class. Online classes allow for students to become distracted by their computer, pets, or family, while in-person classes don't, so we expected students to be distracted. While the similar level of performance was surprising, some respondents reported professors decreased the difficulty of their courses, which meant that while students did not have to pay attention as much, they also didn't need to work as hard.

Familial health and academic achievement played a large part in student anxiety levels. At WPI and BGU, we found that anxiety levels increased or stayed the same – very few students felt less anxiety compared to previous semesters, and those that did feel anxiety specified social anxiety. Many students felt worried about the sudden transition to remote learning and felt anxious about whether they would still be learning the material. Many respondents indicated that they were anxious about their families' health, as their parents were more vulnerable to the virus.

Life experience contributes significantly to the ability to keep control of a schedule. WPI students, in general found it far more challenging to keep track of time and separate leisure and work compared to BGU students. We attributed student's difficulty with time management to their maturity level – in Israel, when someone turns 18, they must serve between two to three years in the military. This mandatory service means that college students at BGU are usually older than college students at WPI, which correlates to a higher life experience level. Furthermore, students at WPI generally have not had to differentiate between work and free time

like people in the military have had to do, so they are less equipped to deal with the stresses that come with working from home. BGU students having better time management skills also led to them using their extra time to maintain or improve their physical health.

Recorded lectures reduce student anxiety and provide schedule flexibility to students. Both students at WPI and BGU overwhelmingly enjoyed the ability to re-watch lectures at their own pace. Being able to watch lectures at any time gave students the ability to flexibly plan their day out. This freedom lowered their academic anxiety and allowed them to use their extra time to work out or engage in recreational activities.

Engineering Students have trouble with working from home. Close to 14% of students at WPI and BGU had inadequate resources to properly attend remote courses. The most frequently unavailable resource was a proper workspace with 44% mention, followed by Wi-Fi with 30%. Students with improper workspaces have bothersome family or pets, or don't have enough room to work. Similarly, our demographic is engineering students, who may require more space or facilities for projects compared to other types of students. We would expect to see a decrease in the percentage of students with inadequate resources if we surveyed non-engineering students.

Students' social life relies on physical distance and spontaneity. WPI and BGU students both saw a dramatic reduction in the amount of social interaction they experienced. Many students went from meeting up with friends more than four times a week to less than one social interaction per week. We can attribute the drop in social interaction to both the COVID-19 physical quarantine as well as the increased amount of personal effort required to plan a meeting compared to pre-pandemic, where students could meet each other on campus at a whim. BGU students, who mainly live off campus, experienced less social interaction before and after the pandemic, likely due to the distance between them.

Recommendations

Our recommendations to universities outline the key aspects of remote education that students found beneficial for their studies that they felt they were inadequately prepared to handle.

We recommend providing supplementary asynchronous material in large courses. Recorded lectures assisted students to manage their time and stress. By providing recorded

lectures universities can allow students to attend lectures conventionally or asynchronously and encourage the students to choose a learning method without penalty. If students prefer to learn using recorded lectures, then providing them allows students to learn in their preferred style. Sections such as labs or discussion should remain mandatory and in-person and should also be recorded for future viewing.

We also recommend continuing to host small meetings, such as office hours and group meetings, online. Our surveys found students enjoyed the freedom and time savings that came from meeting online. Students specifically said that walking to campus was unnecessary when many meetings take only 15 to 20 minutes. We suggest Zoom remain the tool of use, mainly as students are familiar with it and find no major issues with using it in small meetings.

Finally, we recommend universities create a time-management training course for students. This course should teach students how to separate leisure and work through practical examples, such as managing time in an in-person classroom environment and work-from-home environment. This module will help students determine whether they learn better from an in-person or remote environment, which augments our first recommendation.

COVID-19 caused a shift in the way students have perceived learning and combining aspects of remote and conventional education will provide a better experience than either alone.

1.0 Introduction

The coronavirus, now generally referred to as the novel coronavirus disease 2019 (COVID-19), is a global pandemic that has reached almost every country in the world. In many countries, COVID-19 disrupted the education sector, forcing campuses to shut down and schools to move to an online delivery method for education (Emma et al., 2020). Currently, the pandemic has displaced over 1.4 billion students of all levels from campuses worldwide (McCarthy, 2020).

The rapid onset of COVID-19, from the first case in January 2020 to global pandemic two months later (Chappell, 2020), meant that the educational system had little time to prepare for a shift in the way institutions offer traditional education. Many post-secondary institutions introduced an online educational system, where students watch lectures and take tests synchronously or asynchronously. Many institutions look to reports of remote or online learning for what best practices to follow or how to accommodate students learning remotely (Bakia et al., 2012) and to reports of social isolation and loneliness for how to best address the mental health of students (Saade et al., 2017).

Worcester Polytechnic Institute (WPI) in the United States and the Engineering Department at Ben-Gurion University of the Negev (BGU) in Israel are two similarly sized, technically oriented post-secondary institutions that have experienced effects of COVID-19. Both moved online, but the schools themselves have vastly different campus lifestyles and student bases. We decided to look at BGU in addition to WPI as to isolate campus differences and student demographics as the cause of our findings. BGU students are older than WPI students, and far fewer students live on campus at BGU compared to WPI.

Most online-learning studies prior to the COVID-19 pandemic looked at aspects of remote student life with the underlying assumption that students could have an active social life outside of their remote curriculum. Because of the social distancing and quarantine measures of COVID-19, that is no longer a valid assumption. The state of research three months into the pandemic still lacks sufficient information about what we are experiencing, which is not remote learning but more akin to “Emergency Remote Teaching” (ERT) (Hodges et al., 2020). This distinction is the key to connect what historical guidance we have about online learning to the current pandemic, as students will experience the current learning system in a far different way than traditional online learning, where instructors design courses around the online medium

(Gardener, 2020) compared to ERT, where instructors have little time to redesign around the course medium. By looking at the effects ERT has on students, we may come across situations where ERT has improved the educational experience, which we can learn from. Our research on the differences between online learning and ERT allowed us to provide better recommendations for how education at schools like WPI and BGU could improve upon their traditional curriculum.

The goal of this project is to explore student narratives and develop targeted recommendations for how the conventional educational experience at technically oriented post-secondary schools could improve in response to educational and mental health issues that the COVID-19 pandemic uncovered. We completed a set of three objectives to meet this goal:

1. To identify educational and mental health effects on students.
2. To elicit and collect stories from students about their experiences in the COVID-19 pandemic.
3. To compare the benefits and drawbacks of the pandemic educational experience with the conventional educational experience as perceived by students.

This IQP report is built on student experiences and provides recommendations to improve the conventional curriculum.

2.0 Background

On January 7th 2020, Chinese authorities confirmed the outbreak of a new virus known as SARS-CoV-2, or COVID-19 (Muccari & Chow, 2020). In the following months, the virus spread to the rest of the world; on March 11th, 2020, only two months after the confirmation, the World Health Organization (WHO) declared COVID-19 a pandemic (Chappell, 2020). States and countries began to issue stay-at-home orders, and most colleges and universities closed while they re-evaluated their plans for the last few months of school. These circumstances forced students to evaluate whether they were going to go home, how they would get home, and how they would continue school (Roy & Kesslen, 2020). In March of 2020, many universities began to transition to online learning. While online learning was a known educational medium, most students were unfamiliar with it (Lederman, 2018).

This background chapter will mainly look at the state of research related to online learning and students' health before the pandemic. We will begin by looking at the institutional response to COVID-19 of both WPI and BGU Engineering Department, two similarly sized engineering-oriented colleges. Then, it will examine the changes in environment and expectations that students are experiencing, as well as the effects those environments have had on students in the past. Finally, we will look at the current state of research pertaining to mental and physical health in remote learning environments.

2.1 WPI and BGU Response to COVID-19 Pandemic

After the pandemic declaration from the WHO, most schools were unprepared and scrambled to move online; in the United States alone, 124,000 schools of all levels moved to remote education within the span of a month (Coronavirus and school closures, 2020). Remote learning, however, was only one part of the transition – schools also had to send students home and deal with their belongings left behind, and students faced changes in their social life. This section outlines BGU and WPI's response to COVID-19.

2.1.1 Worcester Polytechnic Institute

After the end of the first quarter of the spring semester, WPI began preparations for the COVID-19 pandemic. On March 4th, 2020, WPI sent out an announcement cancelling all university-sponsored travel during the second quarter of the spring semester (Office of the

President, 2020a). On the 11th, WPI officially delayed the start of the second quarter and began the transition to online learning (Office of the President, 2020b), and on March 18th, WPI confirmed that the second quarter would be entirely online (Office of the President, 2020c).

WPI requested that most students on campus return home and recommended all students already at home to stay at home (Office of the President, 2020b). However, some students remained on campus for spring break, and when campus closed, WPI told those who were unable to leave that they could stay (Office of the President, 2020c). With 50% of all students living on-campus (WPI, 2019), the shutdown forced a large population of students to find alternative living arrangements.

Due to the campus closure, students away for spring break were unable to get their belongings back. In response, WPI Residential Services partnered with Boomerang, a moving company, either to ship the student's belongings back to them, or store them until the student could pick them up at their own expense, but with a 10% discount by WPI (Residential Services Office, 2020). Because this option did not work for all students, it was an opt-in program. WPI gave another option for those who did not choose to use Boomerang to retrieve their belongings in-person in early May (Residential Services Office, May 2020).

Students also had to move from an in-person to an online system. While WPI had an online teaching system for graduate courses, most of their courses were asynchronous. WPI's pandemic educational system, however, can also be synchronous and is facilitated through an online video conferencing system known as Zoom. Despite the transfer to Zoom, WPI has had little issue transitioning to this new system. Furthermore, WPI has taken to other kinds of remote learning tools, such as developing alternative ways to work in engineering and science laboratories through virtual reality. These actions enabled WPI students to continue to participate in innovative projects.

2.1.2 Ben-Gurion University of the Negev

Like WPI, BGU began preparations for COVID-19 before the WHO officially classified it as a pandemic. On March 8th, 2020, BGU shut down all academic travel, which included domestic and international (Ben-Gurion, March 8, 2020 Update). On March 12th, they announced that all classes would transition to distance learning starting March 16th (Ben-Gurion, March 12, 2020 Update). Because they were in the middle of the semester, BGU cancelled March 13th and

15th classes, resuming in online mode on the 16th. Compared to WPI, which had two weeks to transfer to online learning, BGU had four days.

Because of the quick turnaround time between in-person and online learning at BGU, there was little time for any students to leave campus. However, there are far fewer students who live on campus at BGU – dormitories hold enough beds for 1,500 students, while BGU has almost 19,000 students. With only 8% of students able to live on campus, far fewer students were caught unaware by the loss of their on-campus housing.

Ben-Gurion did not make an official statement requesting students to go home. In an update to their COVID-19 page on March 15th, 2020, Ben-Gurion stated that those who did not have internet access from home could use the computer labs in student dormitories. A further update on April 1st changed the entry requirements to campus, requiring a signed form stating that the entrant was in good health.

2.2 Changes in Student Environments and Expectations

The transition from a face-to-face education system to a remote education system affected student in three ways: What students face during the transitional period; the new environment they are in after the transition period; and the results that the new environment has on them. Each area consists of both the educational and personal effects on the student. The students' new environments are also shaped by COVID-19 in what resources are available to them or who they are cohabiting with while displaced. Concerning these topics, there currently exists a significant gap in the literature regarding the unique situation of COVID-19. Here we outline the existing relevant literature and explore how the situation described in the literature may have different underlying assumptions or methods than a world during or after COVID-19.

2.2.1 Transitional Period from Conventional Learning

The seismic shift to a remote learning environment forced educational institutions to adjust what they provide to their students, and how. Most students who had been part of institutions forced to move to remote learning did not receive what is traditionally "online education" or "remote education," but instead is a more specific category called ERT. This distinction is vital in identifying where traditional literature may provide less insight in relation to COVID-19. ERT refers to material or instruction that would be delivered in a face-to-face setting if given the opportunity. In contrast, online education refers to material that was designed

and prepared with the intent of delivery through a remote medium ideally accounting for the strengths and weakness of the approach (Hodges et al., 2020; Zimmerman, 2020).

Many colleges in the United States chose to offer “Pass” or “Fail” options for courses to ease the stress on students. This option could allow students to have a course not hurt their grade point average (GPA) if they pass and, effectively, lowers the bar for work expected from the student as there is no distinction between passing grades.

Many educational institutions implemented, or rely more on, online synchronous communication (OSC) systems and virtual learning platforms to manage the distribution and assessment of learning material in response to COVID-19. These platforms and tools may only be effective if all students and educators have reliable access to adequate technology and internet (Vlachopoulos, 2020).

Millions of students across the world changed living situations due to COVID-19, either because of safety concerns, university direction, closed dormitories, or a multitude of other reasons. Where these students go and whom they are surrounded by is still unknown on the aggregate level. Most students seem to have returned to their permanent residences if able, meaning they are living with their family or returning to the living arrangements they were in before college.

In addition to physical living arrangements, COVID-19 disrupted social connections and personal or professional relationships. Past literature identifies the difficulty of collaboration and social connections with peers when evaluating the transition to online learning (Mohd Rahim et al., 2018).

2.2.2 New Personal Environment

COVID-19 shifting students into an online education solution may displace many students by forcing them to leave their campuses or residences. Students who are not displaced still lost communal work and study spaces, as well as dedicated physical spaces for educational assistance or mentorship. Different workplaces can affect motivation and productivity of students significantly (Zhao et al., 2020). Here we explore the implications of a drastic change in environment and what is gained or lost in the transition.

Remote learning due to COVID-19 presents students with issues regarding how and where they accomplish work. COVID-19 presents a unique situation where not only would the

student at home need space to work but they are often competing with peers or other adults at home also in need of workspaces. Competition could present a challenge for physical space or a persistent workplace, which negatively affects productivity and mental health (Kim et al., 2016). When moving away from universities students also lose all the physical infrastructure that the universities invested in such as labs, workplaces, classrooms, or recreation facilities. Students have a wide range of preferences regarding workplace characteristics, which vary based on the type of work they are engaging in. Many educational institutions acknowledge the importance of a workspace that is conducive to productive work for all by providing a range of working accommodations that cannot be reasonably met at home (Beckers et al., 2016).

2.2.3 Best Practices in Remote Education

Pedagogically sound remote courses address certain principals related to education to be best suited for its subject matter. Keengwe & Kidd (2010) propose that an instructor in a remote learning environment has four roles, pedagogical, social, managerial, and technical. The pedagogical role relates directly to the communication and distribution of the educational material, while the social role relates to fostering a remote class environment and creating rapport with the students. The managerial role establishes the course structure and policies, and the technical role revolves around making the platform for the remote learning work best for their case and ensuring the students are comfortable with the platform. The distinct educator skillset required to meet this expectation is different from that of a conventional (face-to-face) educator, which can pose problems when conventional educators move to remote education for any reason. The interactive and pedagogically sound online learning solutions that follow these principals are not being provided by the traditional educational institutions, though guidance and literature on this topic have been widely available (Arum & Stevens, 2020).

For institutions to leverage the advantages of remote education Sun & Chen (2016) say that a course must go through five phases specific to online course design; designing content, developing content, implementing content, evaluating the course, and revising content. In the context of remote education, course design includes implementing multiple methods to engage with the educational content as well as varying mediums of the content. Online discussion boards with set questions to answer as well as responding to the comments of peers fulfilled and engaged students in a way that accounts for possible time-zone difficulties, removes most time

pressure, and fosters social connections between the students. Flexibility regarding assignments and questions as well as direct access to relevant resources for individual pursuit are additional key elements of a successful online course. Providers of ERT cannot properly follow these principals outlined for remote education due to the need for rapid deployment of solutions.

2.3 Health in Online Learning

Universities have chosen to deliver education through remote learning which can affect students' health in a multitude of ways. Many students had to go home due to shutdown of campus or loss of job. In addition, they had to deal with the stress of not knowing what is going to happen next, or how COVID-19 was going to continue to affect their personal lives. Moreover, because students faced isolation from social distancing measures, they cannot release stress by working out, walking around, or hanging out with friends without being wary of COVID. All these factors could affect students' health both psychologically and physically. College students are especially susceptible to mental health issues, with 20% of college students experiencing one or more mental disorders prior to COVID-19 (Auerbach et al. 2016).

Because there is a limited amount of research on COVID-19's effect on students' health, the research presented will primarily be focused on the state of research as it relates to normal online learning. While the COVID-19 pandemic is not normal, this research has the closest relation to the pandemic educational experience.

2.3.1 Mental Health and Online Learning

Online learning, if based in the best practices, can lead students to perform as well as face-to-face learning (Templeton, Ballenger, & Thompson, 2015). However, if universities implement online learning incorrectly, students can experience problems with mental health and motivation. This section will explore the benefits and drawbacks of online learning as it relates to mental health.

Students without online learning experience feel anxious, as shown by Saade et al. (2017) in a study of a business class at Concordia University, Canada. According to Clair (2015), students often feel anxiety as there is no physical anchor to their class. As Lederman (2018) found in his study, many students have not had online learning experience beforehand. With

COVID-19 forcing most higher education online, many students will be experiencing online learning for the first time, which could cause anxiety.

Another drawback to online learning is the student's level of attentiveness. Studies show that the students' minds wander more during online instruction compared to in-person instruction. Using direct probes of attention wandering (stopping lecture and asking the students whether they were daydreaming or not), Lindquist & McLean (2011) found that 33% of probes resulted in daydreaming. Risko et al. (2012), using the same direct probe method in an online situation, found that on average, 43% of all probes resulted in daydreaming. In the current environment, where students may not have as much motivation to learn online as they do in person, attentiveness may end up dropping.

A study by Kim, Liu, & Bonk (2005) looked at Master of Business Administration students taking online courses and found student enjoyment hinged on increased interaction with their instructors. As Saeed & Zyngier (2012) showed, student motivation correlates to engagement. As students are more engaged, they will be more motivated to learn – leading to higher student performance.

According to Kim & Frick (2011), three types of factors can influence student motivation in online learning - internal, external, and personal. Internal factors are course-related factors, such as pacing and access to instructor support. One internal factor, social presence, had mixed effects in student motivation in online learning, leading the authors to believe that online learning success depends on the individual. Kim relates external factors to the learning environment – if students or professors do not understand how to use the technology, then they will have decreased personal motivation for the course. Finally, Kim notes that personal factors relate to the student's circumstances. If the student is having trouble in their personal life, motivation drops. ERT combines many of these factors together – lack of social presence, inexperience with technology, and personal troubles. Because motivation correlates to classroom engagement (Saeed & Zyngier, 2012), students in the COVID-19 era could be less engaged with their online courses.

Online learning can cause anxiety as well as reduce student attentiveness. It also has the potential to cause motivational issues, depending on the school's implementation and the student's own mental state. However, it can also increase student engagement with proper faculty management. While all research up to this point has been with the underlying assumption

that students can go outside and socialize, COVID-19 breaks this assumption by forcing students to stay indoors. Our research found out whether these issues are exacerbated or mitigated by this circumstance.

2.3.2 Physical Health and Online Learning

A lack of physical exercise is harmful to the body, as shown by Mandolesi et al. (2018). Because of COVID-19, many governments have implemented lockdowns, forcing people to stay inside except for essential needs (Kates, Michaud, & Tolbert, 2020). Many countries are following the directives, as shown by Google's COVID-19 Community Mobility Reports. The United States has had a 46% drop in recreational traffic and a 16% drop in park traffic (Google, 2020). With students less likely to leave their homes, there are effects that could occur related to students' movement habits, such as less movement or harm to a person's physical health.

A lack of exercise can cause students to become lazier, affecting motivation and attentiveness. According to a study on physical improvements due to exercise, people who exercise regularly have improvement in their moods, sleep, energy and stamina, and alertness (Weir, 2011). Another study that focuses on the psychological results shows that working out helps the brain fight against depression, anxiety, and other mental issues (Sharma, Madaan & Petty, 2006). However, students are a heavy target of anxiety (Flannery, 2018), and since they are less likely to go outside due to online classes, their mood and attitude could suffer from the lack of physical exercise. Our research looked at the effects of lack of physical activity on students, as found by Google's COVID-19 Community Mobility Reports.

A study by Calestine et al. (2017) shows that students with higher GPAs correlate to a higher Body Mass Index and lower physical activity. Social media presence also influences exercise for students – with high social media use correlating to low levels of physical exercise. With COVID-19 making exercise challenging, we are interested to see if COVID-19 has changed this correlation.

2.3.3 The Impact of COVID-19 on Mental Health

Because COVID-19 is such a new phenomenon, much of the research on mental health impacts on students has not been published or conducted yet. However, before COVID-19, there was an upward trend of stress at college – in the United States, nearly 66% of college students experienced some form of anxiety, up from 40% from five years earlier (Flannery, 2018). This

section outlines the current research available on the psychological impact of COVID-19 on university students.

A study on the mental impact of COVID-19 on college students in China states that students are facing an increase in their anxiety level (Cao et al., 2020). Out of more than 7,100 survey responses, about 25% of the students responded that they felt anxious due to COVID-19 stressors, ranging from mildly to debilitatingly anxious. Breaking the result down, 0.9% of the survey respondents said they are severely anxious, 2.7% are moderately anxious, and 21.3% are mildly anxious. The research stated that the correlation between anxiety and COVID-19 is due to personal economic effects, the disruption of daily routine, and delays in their academic plans. The level of social support a student receives contributes directly to decreasing students' anxiety level. While 25% alone may seem low, 20% of college students globally already experience some form of mental health issue (Auerbach et al, 2016) - anxiety has affected 66% of students in the United States (American College Health Association, 2018) and 12.5% in Israel (Even, 2012). COVID-19 may have caused anxiety for an entirely new group, or further affected the existing group. We uncovered COVID-19's relationship with student anxiety in our research.

A team of psychoanalytical scientists conducted a study in China that analyzed posts on social media websites before and after the pandemic started (Li et al, 2020). They found that negatively charged words have increased as positively charged words decreased. The keywords "depression" and "anxiety" have seen around a 10% increase in usage during COVID-19, with concerns over students' health and people they care about. The reasons for the increase in mental health search terms is the change in the educational environment, lack of entertainment, isolation and lack of physical communication with friends.

COVID-19 has disrupted the educational world by forcing it into a state of Emergency Remote Teaching. In normal circumstances, if colleges utilized online learning poorly, it could cause a multitude of mental health issues and poor lifestyle choices. Combined with COVID-19 causing immense job loss and a sudden change in environment, physically and educationally, there is no precedent for how universities should handle events at this scale. By acquiring stories from students, we hope to fill this gap in knowledge and make recommendations to universities to improve the student experience and increase the resilience of the education system to a pandemic.

3.0 Methods

This project explored student narratives and developed targeted recommendations for how the conventional educational experience at technically oriented post-secondary schools could improve in response to educational and mental health issues that the COVID-19 pandemic uncovered. We completed a set of three objectives to meet this goal:

1. To identify educational and mental health effects on students.
2. To elicit and collect stories from students about their experiences in the COVID-19 pandemic.
3. To compare the benefits and drawbacks of the pandemic educational experience with the conventional educational experience as perceived by students.

Through these objectives, we developed a series of recommendations for technically oriented post-secondary schools to help improve the traditional educational experience in a post COVID-19 pandemic world. We surveyed and interviewed students at WPI and the Engineering Department of BGU. We targeted these recommendations at parts of the educational experience, such as student experience, student support networks, and classroom logistics. We performed these objectives beginning on May 26th, 2020 and ended on July 9th, 2020. Our methods follow in order of our objectives – we explain how we identify educational and mental health effects, then we explain how we elicit stories, and end with our comparison methods.

3.1 Identify Educational and Mental Health Effects

We aimed to identify educational and mental health effects on students at WPI and BGU through surveys. By using online surveys through the Qualtrics platform, we explored possible factors that contribute to the way a student experiences education during the pandemic. We examined the education they are receiving, and the change COVID-19 caused in their lives as students.

We utilized surveys to gain an overview of student experience and sentiment. We used the survey data in combination with student stories to draw our conclusions. Our survey focused on engineering students at WPI and BGU. To acquire the students' perspectives, universities or specific departments sent out emails with a web link to our survey. BGU sent out the email to engineering departments and at WPI the Biomedical, Mechanical, Robotics, and Electrical and

Computer Engineering departments distributed our survey. We acquired 146 survey responses from WPI and 127 from BGU.

The survey collected responses to questions in three categories: First, demographics of the respondent such as gender, year of study, and socioeconomic background; second, perceived effects on education such as how well respondents feel they perform academically prior and during the pandemic or how they perceive the quality of the education they are receiving compared to previous semesters; lastly, the respondent's perceived effects of COVID-19 on their mental health or daily life.

The demographic information offers context to the responses by exploring how issues or effects may disproportionately affect students of a certain background. By exploring how students feel their academic performance changed or did not change, in conjunction with their perception on the change in quality of their education, we may establish how some students feel about the shift to remote education. Additionally, changes in daily life such as social interaction, working or living conditions, or routines serve to convey the secondary effects of the pandemic and shift in the education system.

We worked with the Student Development and Counseling Center (SDCC) at WPI to ensure that all questions are respectful to students and to present them in a manner that best conveys the intent of the question. We were concerned that questions related to mental health may over-step some boundaries, which the SDCC helped alleviate.

We created a survey such that all the survey responses were anonymous using the "Anonymous Link" in the Qualtrics platform. In practice, the use of this feature means that no name or IP address will be collected, and the survey platform will anonymize responses before we receive them. The use of an anonymous survey aims to encourage honesty in a no-risk environment to protect the integrity of the study and identity of the students. However, we included an optional contact information question in the survey if the student is willing and able to participate in an interview. If the respondent answers yes to this question, when they complete the survey, the survey redirects them to a second survey where they can leave their email address unlinked to their survey answers. If an individual chooses to provide contact information, we may reach out to them through email.

3.2 Elicit and Collect Stories

To understand the response of students to the COVID-19 pandemic, we thought it helpful to have more than an impersonal, macro-level survey. After augmenting our current interview subject areas with questions and information derived from our survey results, we conducted remote video interviews of individuals who communicated their interest in an interview. The interviews enabled careful exploration of content that may be more sensitive or relate to mental health and document the story of the individual. This process allowed us to contextualize the discussions we have or any findings that result from an interview.

3.2.1 Remote Interview

We conducted interviews of students at both WPI and BGU to get a better understanding of how they were affected at the personal level. We contacted these students through the surveys, where our team reached out to those who left their email, and we followed up with 33 people, with ten of whom we were able to schedule interviews. Appendix B contains the base list of questions that we asked in every interview.

Our interviews were semi-structured, meaning we had a base list of questions and would deviate as necessary. We did this so that we could explore topics specific to each interviewee – if one interviewee had an interesting anecdote that did not necessarily fit into any of our questions, we wanted the freedom to follow it.

We conducted all interviews remotely over a synchronous communication platform, Zoom. After individuals indicate a willingness to participate in an interview, we reached out to them to inform them of general topics we would like to ask them about in the interview and to plan a time to conduct the interview. We provided advance notice of the topics in an attempt to allow the individual the opportunity to retract their interest in participating before we place them in a situation where that may be awkward for them. In addition, they were free to stop the interview at any time. We additionally asked the individual if they are willing to have the interview audio recorded for transcription purposes. All participants provided consent to be recorded. For the preamble to our interview, see Appendix A.

3.2.2 Mental Health

Due to the potentially sensitive nature of mental health we worked with the Student Development and Counseling Center (SDCC at WPI) to prepare specific questions regarding this sensitive subject matter. We also sought guidance on topics or questions to exclude from an interview, or best practices for conducting interviews of this nature. Mental disorders in categories such as anxiety, depression, or attention-deficit as recognized by the American Psychiatric Association in the Diagnostic and Statistical Manual of Mental Disorders are of interest to this study. The SDCC explained to be direct with our questions, which is the most respectful way of asking about mental health. In implementing this advice, we found that it was very effective at getting stories and responses.

3.3 Compare Benefits and Drawbacks of ERT

We developed a set of general categories of responses regarding the emergency remote learning caused by COVID-19. We first took our interviews and extracted underlying themes from them. Then, we aggregated the interview data with our survey responses, creating a basis for us to create recommendations.

3.3.1 Analyze Interviews

We assigned each member of the team three to four interviews to transcribe. Additionally, the transcripts omitted some utterances such as “like” or “Umm” for clarity. We explored each interview extensively and performed content analysis.

We analyzed the quotes using content analysis, and followed the steps outlined by Erlingsson & Brysiewicz (2017). We took our data, which is at a very low level of abstraction, and abstract it to reflect the meaning of what was said.

Our first step was to read the transcript and note our initial reactions. We then re-read the transcript and revised our notes. We continued to reread until we fully understood the interview. This step allowed us to get a full impression of the interview and check our themes such that the impressions reflect what we gained from the interview.

Next, we extracted quotes from the interview – called Meaning Units (MUs) which provided a view of the themes of the interview. We then condensed these MUs to Condensed

Meaning Units (CMUs) that encapsulated the meaning. The switch from MU to CMU removed unnecessary information from the quote and allowed us to directly assess the themes.

Our third step was to assign every CMU a "Code" which described the unit in a concise way. The code does not need to be taken directly from the unit but can be a reason for why the unit exists. For example, when students talked about the stresses that comes from online learning, we assigned the "Anxiety" code to that CMU.

Finally, we combined the codes and CMUs into themes. We started by sorting all the related codes into categories or themes (e.g. physical health, or academic performance.) Each of these themes can have subthemes within them.

At this point, we had codes, CMUs, and themes from every interview. The next task was to combine all of them into a cohesive list, that has elements from every interview. Once we compiled this list, we connected our findings to the survey data.

3.3.2 Aggregate Data

With the interview themes found, we connected them to the survey data. If the themes found in the interview lined up with the average sentiment from survey responses, we said that it was an overarching theme within our data. The interview data also helped contextualize the survey responses, which provided us a greater understanding of the student experience. This process is known as a mixed-method approach, which uses qualitative data to explore quantitative findings (Wisdom & Cresswell, 2013).

We based our recommendations at the institutional level, so we needed to determine whether the themes were related to a certain part of the institution. For example, if students are feeling more depressed, the depression could be connected to the student support services of the school.

3.3.3 Draw Conclusions and Recommendations

Our final step was drawing conclusions from the overarching themes and producing recommendations from them. Our findings section was based on the overarching themes and includes sample data such as snippets of the interviews.

From that knowledge base, we built a set of recommendations on how technically oriented post-secondary schools can improve the education they provide to accommodate the

lessons learned during the COVID-19 educational period from student experiences. For raw survey data, see Appendix C and D.

4.0 Results and Analysis

By surveying and interviewing students at WPI and BGU, we developed an understanding of how students experienced the COVID-19 pandemic from an academic and personal perspective. This chapter will focus on identifying the themes that have emerged from our findings, such as lower engagement in online learning, higher student anxiety, students' time management abilities, physical health's relationship to time management, and recording lectures reducing stress.

4.1 Engagement in Online Learning

At both WPI and BGU, we found that students experienced lower levels of academic motivation. Both WPI and BGU students reported a lower level of attentiveness to their academics but reported only a slight drop in self-perceived performance compared to the Fall 2019 semester when comparing it to how much attentiveness dropped. We attribute these results to a lack of engagement – when faced with online learning, students get distracted or overwhelmed by real-world interferences or their workload respectively and tend to lose interest in class. Online classes allow for students to become distracted by their computer, pets, or family, while in-person classes don't, so we expected students to be distracted.

In our survey, we asked students how they felt their motivation had changed compared to pre-pandemic times. Most students at both WPI and BGU said that their motivation decreased as a result of the shift to online learning, as shown in Figure 1.

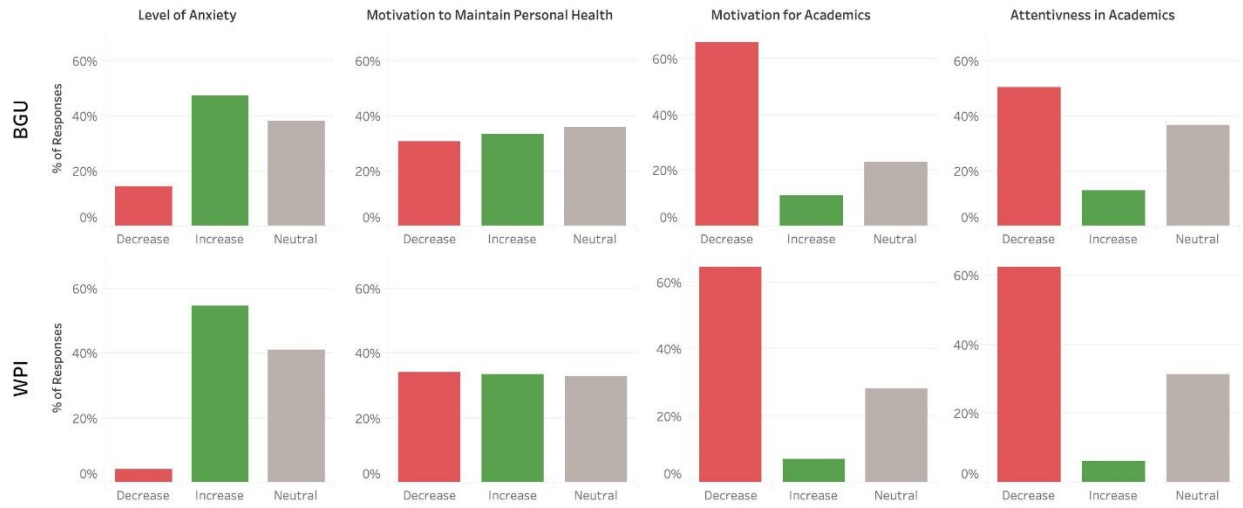

Figure 1 Respondent perception of motivation, attentiveness, and anxiety during the COVID-19 pandemic

This theme was prevalent in our interviews as well. A WPI student noted that she "was not busy enough to be motivated," saying that she had too much free time as a result of her classes shifting to a no-lecture format. Conversely, a BGU student explained that she lost motivation as her classes overcompensated in the amount of work they assigned, stating that "the thought of watching so many hours [of lecture], it's kind of like 'I can't do that.'" We conclude that work imbalance in remote learning can lead to a loss of motivation.

Furthermore, we noticed that students had trouble focusing on classes, mainly due to real-world interferences, such as pets or computers. Students who live with pets have issues where their pets would interrupt them in the middle of class, forcing them to leave lecture, and some students would log onto to class, get distracted by something on their computer, and stop paying attention. Conventional education does not have this issue as students learn in a room whose sole purpose is for learning. In online education, a students' computer has many uses, many of which can distract from learning.

4.2 Student Anxiety Levels

At WPI and BGU, we found that anxiety levels increased or stayed the same – few students felt less anxiety compared to previous semesters. Many students felt worried about the sudden transition to remote learning as well as whether they would still be learning the material.

Most respondents indicated that they were anxious about their families' health, as their parents were vulnerable to the virus.

Our survey asked students how they felt, and most of them responded that their anxiety increased compared to previous semesters, as shown in Figure 1. Those who felt that they had less anxiety tended to specify that it was social anxiety rather than academic.

COVID-19 caused our interviewees a lot of stress as well, and this stress was mainly related to their family. Both WPI and BGU interviews produced strong themes about the fear of interviewees bringing home the virus and killing their family, as explained by a WPI student, "There's already 4 people in my house, where if I brought it home, I could potentially kill all of them. That gave me so much anxiety."

4.3 Life Experience and Time Management

WPI students, in general, found it far more challenging to keep track of time and separate leisure and work compared to BGU students. We attributed this to the life experience level of students – in Israel, when someone turns 18, they must serve between two to three years in the military, and many choose to attend university after.

WPI respondents focused on their inability to separate academics and leisure time, noting that they had too much downtime and weren't able to manage their time properly because of that. This theme was prevalent in our interviews as well, where one student said that he had to put in a lot of effort to keep track of his time to force himself to work. Another student said that she wasn't splitting her academic and free time and procrastinated as a result.

Conversely, BGU respondents felt that they were able to separate academic and free time – there were not many responses that indicated students were having trouble with time management. Many of the responses showed that students were not procrastinating compared to WPI students. One of our interviewees noted that she was able to enjoy time with her family as well as study more effectively due to quarantine.

We believe that BGU students' more effective time management skills are due to them having more experience outside of college compared to WPI students. Because BGU students spend over two years in the military, they are older and more experienced than WPI students.

The military gave them experience managing their time and enduring heavy stress, which contributed to their ability to handle the pandemic.

BGU student's additional life experience led to better physical health as well. WPI respondents overwhelmingly mentioned that they had fallen out of shape and stopped working out, while a significant portion of BGU students said that they were able to use this time to work out more and get in better shape.

Both WPI and BGU students showed a roughly even split between more motivation, less motivation, and no change in motivation to maintain their health, as shown by Figure 1. However, WPI survey responses focus heavily on the fact that they had fallen out of shape and ended up gaining weight, which shows that the WPI students who reported "no change" leant towards less motivation. One interviewee said that she had gained weight in quarantine after stopping her diet due to boredom.

BGU survey responses, however, show that they were able to work out or stay in shape, which means their "no change" leant towards more motivation. We can attribute this to their time management abilities, as WPI students tend not to spend their free time as effectively. Twenty-one percent of BGU respondents spent their extra time cooking better or exercising.

4.4 Recorded Lectures Create Flexibility

Both students at WPI and BGU overwhelmingly enjoyed the ability to re-watch lectures at their own pace. Being able to watch lectures at any time gave students the ability to plan their day out flexibly. This freedom lowered their academic anxiety and allowed them to use their extra time to work out or engage in recreational activities. If students have good time-management skills, this is good. Students that have poor time management skills may find themselves using this extra time to procrastinate rather than work.

When asked about what they liked about online learning, WPI and BGU students overwhelmingly said that they enjoyed recorded lectures and online personal meetings (office hours, group meetings) and want to continue using them once we resume conventional education. They cited reasonings such as being able to speed up or slow down the lecture or go back if they missed being able to take notes. Being able to control the speed of the lecture reduces learning stress and allows for more efficient notetaking.

"Zoom meetings with professors were an excellent use of the software and provided a good one on one experience between both parties with fewer distractions" - *WPI Respondent*

Being able to control lecture timing also gives students more control over their lives. One BGU interviewee said that she was able to close the lecture when her pets bothered her, and resume it later at the same spot, and was able to complete her notes with no issues. A WPI interviewee said that he found online meetings easier because there was no need to walk to WPI, meet with the TA, and walk back – it saved him a lot of time to "jump on a call, go over something, and [be] done."

4.5 Workspace and Demographics

Close to 14% of students at WPI and BGU had inadequate resources to properly attend remote courses. The most frequently unavailable resource was a proper workspace with 44% mention, followed by Wi-Fi with 30%. With COVID-19 causing everybody to work from home, it is harder to find space for everybody. Similarly, our demographic is engineering students, who may require more space or facilities for physical projects than other types of students.

Improper workspaces can take many forms. Some respondents mentioned having too small of a desk to work on, while others cited their workspace as not being private enough. One BGU respondent noted that her cat would be bothering her while she was in class, to the point where she would have to close her laptop mid-lecture. A WPI student mentioned that, because she worked in the kitchen, her dad would constantly and loudly barge in on her during meetings.

Students without Wi-Fi had a tough time in the switch to remote education. We interviewed a BGU student who had to drop out of the semester – she noted that she was a high-achieving student but did not have the proper tools to attend remote courses.

Our study demographic, engineering students, require large workspaces and labs to work effectively. In the shift to remote education, many of them lost those facilities and had nothing to replace them. We would expect a study focusing on other disciplines, such as humanities, to have a lower percentage of students with inadequate resources due to the nature of the discipline.

4.6 Socialization and Spontaneity

WPI and BGU students both saw a dramatic reduction in the amount of social interaction they experienced. Many students went from meeting up with friends more than four times a week to less than one social interaction per week, as shown by Figure 2. We can attribute the drop in social interaction to both the COVID-19 physical quarantine as well as the increased amount of personal effort required to plan a meeting.

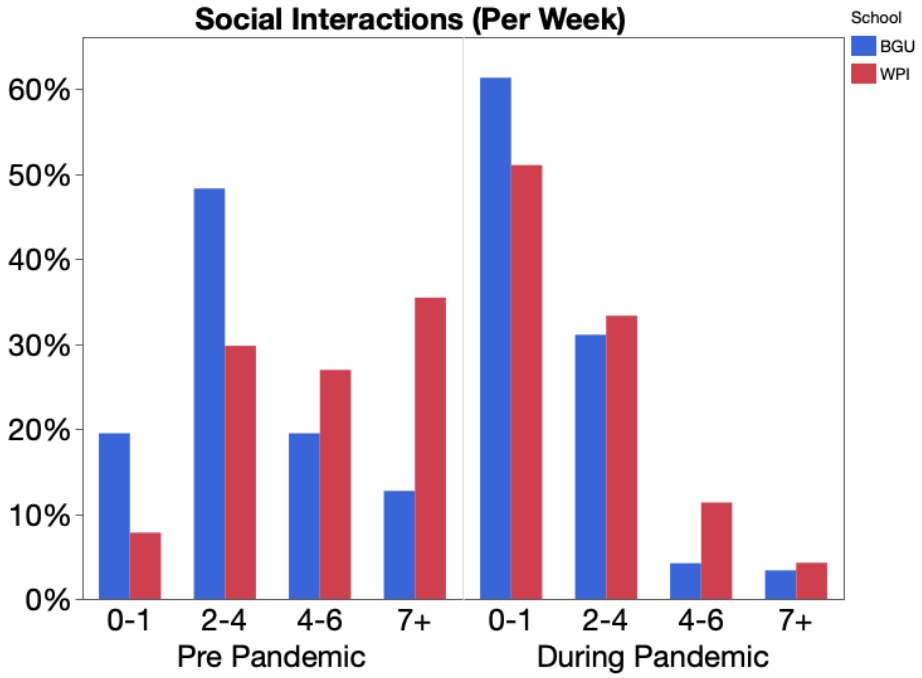

Figure 2 Social interactions per week of WPI and BGU students

Many students cited that social interaction was easier on-campus due to being able to see their friends constantly. A WPI respondent told us that it was "more convenient to hang out with your friends when you see them every other day in passing anyway." They also mentioned that it was harder to hang out with friends when they had to put in a significant amount of effort to meet up. Another WPI respondent said that she scheduled weekly meetings with her friends to stay in contact.

Social interaction seems to rely on spontaneity and close physical distance, and with quarantine causing less of both, students have seen more social isolation. BGU students interacted less before the pandemic compared to WPI students, likely due to them living off

campus and being far away from each other. For WPI students, they must put in more work to see their friends compared to meeting them on campus, which means less interaction overall.

5.0 Conclusions and Recommendations

Although COVID-19 is a devastating pandemic that has fundamentally changed our society, there are silver linings, however small, that come with it. It is our responsibility to take what good is available and to use it. This pandemic has shown potential for the education system in the future, and we must take action to improve it.

Our recommendations to universities outline the key aspects of remote education that students found beneficial for their studies that they felt they were inadequately prepared to handle.

5.1 Recorded Lectures

Our findings indicate that students enjoy having the opportunity to re-watch lectures on their own time or at a different pace. Recorded lectures allowed them to handle their time better which contributes to lower feelings of stress and anxiety. In response to this, we recommend professors to record large lectures and make limited synchronous material optional.

By reducing the temporal constraints on students, universities allow them to manage their time and energy with regards to academics more effectively. Students are under less pressure to attend class at the designated meeting time if a more pressing issue or another event appears at that time. While the recording of lectures is becoming widespread, the removal of consequences for choosing to attend a course asynchronously, such as punishment for lack of physical attendance, can have a positive effect on students in many other aspects of their lives. Other synchronous material, such as discussions and labs, should remain mandatory and in-person, but still recorded for future viewing if appropriate.

5.2 Small Online Meetings

We concluded that small online meetings, such as office hours or some group meetings, are beneficial for many students as online meetings save time, and professors should implement them in the return to conventional education. Currently, professors offer office hours primarily in-person. Students are spending time walking across campus and trying to find space to work on a project or discuss how to divide the work between them. Time loss can be frustrating during the peak hours and finals weeks. However, universities continuing to provide online meeting

services, such as Zoom, may be a solution for those who would rather work from their personal space. Online meetings will lead to having more free space in the library or student centers for those who need it for non-discussion work, as students will mostly zoom from home.

Our findings show that students liked having office hours offered online. It was more convenient for them than walking to a professor's office. A student recommended in an interview that a way to do that is for the professor to have a Zoom meeting opened in the same in-person office hours. This way, a student who feels unable to go to the professor's office, for reasons such as shyness or sickness, can receive help. In this case, offering online office hours does present the potential drawback of reduced personal contact between the student and instructor, but more students will be able to engage with an instructor and exceptions can be made if need to meet in-person.

5.3 Time Management Module

Our findings indicate that many students have problems with time management and understanding how to separate work and leisure during the pandemic. They also indicate that while some students have problems with remote learning, some find online learning beneficial. To address this, we recommend that universities provide a module that trains students in time management, as well as helps them decide their preferred learning method.

Using this module, students who are unskilled in time management can train themselves in preparation for the real world. First-year students entering college can also use it to discover whether they prefer in-person or recorded lectures and craft their college experience around it. Other course material, such as discussions, should remain synchronous so we do not expect this module to cover those types of material.

For future projects, we recommend interviewing students in a broader range of disciplines, not only engineering. We also suggest collecting more surveys and interviews, as the time constraints led us to pursue a small sample size of universities and students. Finally, we suggest examining changes in student academic performance data during the pandemic time period to better help correlate attentiveness, motivation, and performance. Through a continuation or implementation of recommendations from this project students will be better

equipped to learn in a way that best suits them, and schools will step towards a new period of education that is better for all.

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Appendix A: Interview Questions

Hello, my name is […]. Thank you for agreeing to participate in an interview, you may choose to not answer any question or stop at any time. The goal of our project is to improve the conventional educational experience using student narratives of the pandemic educational experience. Would you allow us to record this interview for transcription? We will scrub the transcription of any identifying information. Do you have questions?

1. Transitional period experience (moving back to family, etc)
    a. Can you take us through what you did after the announcement of the shift to remote learning?
    b. What were your thoughts on your new environment?
2. Mental health (anxiety, motivation, depression)
    a. Did you experience any anxiety or depression before COVID-19?
    b. Have you experienced any changes in these symptoms due to COVID-19? Why?
3. Performance and attentiveness in class
    a. Do you feel like your attentiveness in class was affected by online learning? Why?
    b. Did your performance in class suffer compared to pre-COVID? What do you think caused this?
4. Economic impact (job loss)
    a. Did you have a job (or were going to have one) before COVID-19 hit?
    b. (If yes) Did you lose this job? Did you get any compensation? What happened?
    c. Did you feel the economic impact of COVID-19? How? What are your thoughts on what happened?
5. Workspace availability
    a. Did you have enough resources to attend remote courses properly?
    b. Did you have your own workspace? Did you have to share?
6. Social life
    a. Have you kept in contact with your friends or peers during the pandemic?
    b. Have the dynamics surrounding interactions with your friends changed due to COVID-19? How and why?
7. Class adaptations (perception and action)
    a. How have your courses adapted to remote learning, and what do you think about that?
8. New daily life (routine, physical health)
    a. Have you dropped any healthy habits from pre-pandemic, such as working out or eating well? Why?
9. Opinion of institutional response
    a. What is your opinion on the response of your university? Do you think they should have done more or less?
    b. How do you think this process could have been made better for you?

c. What do you like about what your institution has been doing in response to COVID-19? Do you think they should continue doing this when we return from the pandemic?

10. Conclusion
    a. Is there anything else you would like to share?

Appendix B: Survey Questions

We are a group of students from Worcester Polytechnic Institute in Massachusetts working to explore the effects of the COVID-19 global pandemic on students. This information will help us understand various ways that you may have been affected in both your educational and personal lives.

Your participation in this survey is completely voluntary and you may skip any question or withdraw at any time. Your responses will remain anonymous and no identifiable information will be used in any project report or publication. At the conclusion of the survey you will have the option to provide contact information in a separate form that is not associated with your survey answers if you would be willing to participate in a remote interview. If you chose to provide these contact details, we will contact you through e-mail or another contact method to provide you with more information and set up a time for an interview.
This survey is expected to take between 5 and 10 minutes to complete, any question may be skipped if you do not feel comfortable providing an answer.
Your participation is greatly appreciated.

You may contact us at gr-e20wpi-covidedu@wpi.edu if you have any questions or concerns.

Start of Block: Demographics

Q1 What is your age?

- ○ Less than 18 (1)
- ○ 18 (2)
- ○ 19 (3)
- ○ 20 (4)
- ○ 21 (5)
- ○ 22 (6)
- ○ 23 (7)
- ○ 24 (8)
- ○ 25 (9)
- ○ 26 (10)
- ○ Greater than 27 (11)

Skip To: End of Survey If What is your age? = Less than 18

Q2 What was your year of study in the spring 2020 semester?

- ○ 1st Year (1)
- ○ 2nd Year (2)
- ○ 3rd Year (3)
- ○ 4th Year (4)
- ○ 5th Year or Later (5)

Q3 What is your gender?

- ○ Male (1)
- ○ Female (2)
- ○ Prefer not to say (3)
- ○ Other (4) _____

End of Block: Demographics

Start of Block: Academics

Q6 What is your major field of study? Please select the closest option

▼ Aerospace Engineering (1) ... Structural Engineering (17)

Q7 If applicable, please select your secondary field of study

▼ Aerospace Engineering (1) ... Structural Engineering (17)

Q8 How would you rate your academic performance on a scale of 1 to 10 in the following semesters?

0 1 2 3 4 5 6 7 8 9 10

Fall 2019 Semester ()	
Spring 2020 Semester ()	

Q13 Do you feel you are receiving the same quality of education as you did previously?

- Strongly Disagree (1)
- Disagree (2)
- Agree (3)
- Strongly Agree (4)

Q14 Based on the previous question, would you say that your education has changed positively or negatively?

- Negative (1)
- Neutral (2)
- Positive (3)

End of Block: Academics

Start of Block: Living Situation

Q9 Where did you live before the COVID-19 pandemic?

- ○ With Parents or Guardians (1)
- ○ Off-Campus Housing (2)
- ○ On-Campus Housing (3)
- ○ Other (4) _____

Q10 Where were you during spring break or directly after your university's decision to move to remote courses?

- ○ With Parents or Guardians (1)
- ○ Off-Campus Housing (2)
- ○ On-Campus Housing (3)
- ○ On Vacation (4)
- ○ Other (5) _____

Q11 Where did you go when campus closed?

- ○ To Parents or Guardians (1)
- ○ To Off-Campus Housing (2)
- ○ Staying on Campus (3)
- ○ On Vacation (4)
- ○ Other (5) _____

End of Block: Living Situation

Start of Block: Health

Q12 How often..

	0-1 times per week (1)	2-4 times per week (2)	4-6 times per week (3)	greater than 7 times per week (4)
did you engage in social activities (any activities with friends) before the COVID-19 pandemic? (1)	○	○	○	○
do you engage in online social activities (any activities with friends) in light of the recent pandemic? (2)	○	○	○	○

Q15 As a result of COVID-19, have you experienced a change in your...

	Decrease (1)	Neutral (2)	Increase (3)
level of anxiety? (1)	○	○	○
level of motivation for academics? (2)	○	○	○
level of motivation to maintain personal health? (4)	○	○	○
level of attentiveness in academics? (3)	○	○	○

Q16 Before the pandemic, were you diagnosed with any condition(s) related to mental health?

- ○ Yes (1)
- ○ No (2)

Q17 Have you noticed any changes in your mental health as the pandemic has progressed?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Have you noticed any changes in your mental health as the pandemic has progressed? Shown for Yes

Q18 Would you like to say a few words on how this has affected your academic performance?

_____

Q19 How do you feel the pandemic has affected your physical health?

- Negatively (1)
- Neutral (2)
- Positively (3)

Display This Question:

If How do you feel the pandemic has affected your physical health? Not shown for Neutral

Q30 Would you like to say a few words on how your physical health has been affected?

_____

End of Block: Health

Start of Block: Home Life

Q20 Do you currently have adequate access to what you need to be successful in academics? Examples might include Wi-Fi, workspace, or educational materials.

- Yes (1)
- No (2)

Display This Question:

If Do you currently have adequate access to what you need to be successful in academics? Examples mi... Shown for No

Q21 What do you feel you do not have adequate access to?

_____

Q22 Are you experiencing or have you experienced food insecurity during the pandemic?

- Yes (1)
- No (2)

Q23 Did you have a job (or were going to have one) before the pandemic?

- Yes (1)
- No (2)

End of Block: Home Life

Start of Block: Conclusion

Q24 Would you like to share any other information pertaining to your experiences with COVID-19, changes in your daily life or routine, or additional information regarding any of the previous questions?

_____

Q29 If there are any aspects of remote or online learning that you found beneficial and/or would like to continue after the pandemic, please mention them here.

_____

Q27 If you would like to be contacted by us for a remote interview, please select "Yes" and follow the link after you submit this survey. This information is not linked to your survey responses.

- ○ Yes (1)
- ○ No (2)

End of Block: Conclusion

Appendix C: WPI Survey Responses

Q1 - What is your age?

#	Answer	%	Count
1	Less than 18	2.74%	4
2	18	6.16%	9
3	19	17.81%	26
4	20	26.03%	38
5	21	23.97%	35
6	22	11.64%	17
7	23	6.16%	9
8	24	0.68%	1
9	25	0.68%	1
10	26	2.05%	3
11	Greater than 27	2.05%	3
	Total	100%	146

Q2 - What was your year of study in the spring 2020 semester?

#	Answer	%	Count
1	1st Year	18.44%	26
2	2nd Year	26.24%	37
3	3rd Year	34.04%	48
4	4th Year	14.89%	21
5	5th Year or Later	6.38%	9
	Total	100%	141

Q3 - What is your gender?

#	Answer	%	Count
1	Male	53.90%	76
2	Female	42.55%	60
3	Prefer not to say	0.71%	1
4	Other	2.84%	4
	Total	100%	141

Q6 - What is your major field of study? Please select the closest option

#	Answer	%	Count
1	Aerospace Engineering	0.00%	0
2	Architectural Engineering	0.00%	0
3	Biomedical Engineering	5.71%	8
4	Biotechnology Engineering	0.00%	0
5	Chemical Engineering	0.71%	1
6	Civil Engineering	0.00%	0
7	Communication Systems Engineering	0.00%	0
8	Environmental Engineering	0.00%	0
9	Electrical and Computer Engineering	38.57%	54
10	Industrial Engineering	0.00%	0
11	Management Engineering	0.00%	0
12	Materials Engineering	0.00%	0
13	Mechanical Engineering	46.43%	65
14	Robotics Engineering	7.86%	11
15	Software Engineering / Computer Science	0.71%	1
16	Software and Information Systems Engineering	0.00%	0
17	Structural Engineering	0.00%	0
	Total	100%	140

Q7 - If applicable, please select your secondary field of study

#	Answer	%	Count
1	Aerospace Engineering	6.12%	3
2	Architectural Engineering	0.00%	0
3	Biomedical Engineering	4.08%	2
4	Biotechnology Engineering	0.00%	0
5	Chemical Engineering	0.00%	0
6	Civil Engineering	2.04%	1
7	Communication Systems Engineering	2.04%	1
8	Environmental Engineering	0.00%	0
9	Electrical and Computer Engineering	14.29%	7
10	Industrial Engineering	2.04%	1
11	Management Engineering	0.00%	0
12	Materials Engineering	4.08%	2
13	Mechanical Engineering	36.73%	18
14	Robotics Engineering	12.24%	6
15	Software Engineering / Computer Science	16.33%	8
16	Software and Information Systems Engineering	0.00%	0
17	Structural Engineering	0.00%	0
	Total	100%	49

Q8 - How would you rate your academic performance on a scale of 1 to 10 in the following semesters?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Fall 2019 Semester	2.00	10.00	8.03	1.74	3.01	140
2	Spring 2020 Semester	1.00	10.00	7.19	2.30	5.27	139

Q13 - Do you feel you are receiving the same quality of education as you did previously?

#	Answer	%	Count
1	Strongly Disagree	20.57%	29
2	Disagree	51.77%	73
3	Agree	23.40%	33
4	Strongly Agree	4.26%	6
	Total	100%	141

Q14 - Based on the previous question, would you say that your education has changed positively or negatively?

#	Answer	%	Count
1	Negative	63.83%	90
2	Neutral	31.91%	45
3	Positive	4.26%	6
	Total	100%	141

Q9 - Where did you live before the COVID-19 pandemic?

#	Answer	%	Count
1	With Parents or Guardians	8.51%	12
2	Off-Campus Housing	43.97%	62
3	On-Campus Housing	43.97%	62
4	Other	3.55%	5
	Total	100%	141

Q10 - Where were you during spring break or directly after your university's decision to move to remote courses?

#	Answer	%	Count
1	With Parents or Guardians	51.77%	73
2	Off-Campus Housing	19.86%	28
3	On-Campus Housing	7.09%	10
4	On Vacation	15.60%	22
5	Other	5.67%	8
	Total	100%	141

Q11 - Where did you go when campus closed?

#	Answer	%	Count
1	To Parents or Guardians	72.34%	102
2	To Off-Campus Housing	21.99%	31
3	Staying on Campus	1.42%	2
4	On Vacation	1.42%	2
5	Other	2.84%	4
	Total	100%	141

Q12 - How often..

#	Question	0-1 times per week		2-4 times per week		4-6 times per week		greater than 7 times per week		Total
1	did you engage in social activities (any activities with friends) before the COVID-19 pandemic?	7.80%	11	29.79%	42	26.95%	38	35.46%	50	141
2	do you engage in online social activities (any activities with friends) in light of the recent pandemic?	51.06%	72	33.33%	47	11.35%	16	4.26%	6	141

Q15 - As a result of COVID-19, have you experienced a change in your...

#	Question	Decrease		Neutral		Increase		Total
1	level of anxiety?	4.26%	6	41.13%	58	54.61%	77	141
2	level of motivation for academics?	66.19%	92	27.34%	38	6.47%	9	139
3	level of motivation to maintain personal health?	34.75%	49	31.91%	45	33.33%	47	141
4	level of attentiveness in academics?	63.12%	89	31.21%	44	5.67%	8	141

Q16 - Before the pandemic, were you diagnosed with any condition(s) related to mental health?

#	Answer	%	Count
1	Yes	22.14%	31
2	No	77.86%	109
	Total	100%	140

Q17 - Have you noticed any changes in your mental health as the pandemic has progressed?

#	Answer	%	Count
1	Yes	49.65%	70
2	No	50.35%	71
	Total	100%	141

Q19 - How do you feel the pandemic has affected your physical health?

#	Answer	%	Count
1	Negatively	46.10%	65
2	Neutral	42.55%	60
3	Positively	11.35%	16
	Total	100%	141

Q20 - Do you currently have adequate access to what you need to be successful in academics? Examples might include Wi-Fi, workspace, or educational materials.

#	Answer	%	Count
1	Yes	85.82%	121
2	No	14.18%	20
	Total	100%	141

Q22 - Are you experiencing or have you experienced food insecurity during the pandemic?

#	Answer	%	Count
1	Yes	12.23%	17
2	No	87.77%	122
	Total	100%	139

Q23 - Did you have a job (or were going to have one) before the pandemic?

#	Answer	%	Count
1	Yes	63.12%	89
2	No	36.88%	52
	Total	100%	141

Appendix D: BGU Survey Responses

Q1 - What is your age?

#	Answer	%	Count
1	Less than 18	0.79%	1
2	18	0.79%	1
3	19	3.94%	5
4	20	9.45%	12
5	21	5.51%	7
6	22	9.45%	12
7	23	5.51%	7
8	24	6.30%	8
9	25	14.17%	18
10	26	11.81%	15
11	Greater than 27	32.28%	41
	Total	100%	127

Q2 - What was your year of study in the spring 2020 semester?

#	Answer	%	Count
1	1st Year	20.00%	25
2	2nd Year	31.20%	39
3	3rd Year	27.20%	34
4	4th Year	16.00%	20
5	5th Year or Later	5.60%	7
	Total	100%	125

Q3 - What is your gender?

#	Answer	%	Count
1	Male	56.00%	70
2	Female	43.20%	54
3	Prefer not to say	0.80%	1
4	Other	0.00%	0
	Total	100%	125

Q6 - What is your major field of study? Please select the closest option

#	Answer	%	Count
1	Aerospace Engineering	0.00%	0
2	Architectural Engineering	3.77%	4
3	Biomedical Engineering	4.72%	5
4	Biotechnology Engineering	0.94%	1
5	Chemical Engineering	16.98%	18
6	Civil Engineering	1.89%	2
7	Communication Systems Engineering	0.94%	1
8	Environmental Engineering	3.77%	4
9	Electrical and Computer Engineering	3.77%	4
10	Industrial Engineering	1.89%	2
11	Management Engineering	0.94%	1
12	Materials Engineering	0.00%	0
13	Mechanical Engineering	50.00%	53
14	Robotics Engineering	5.66%	6
15	Software Engineering / Computer Science	3.77%	4
16	Software and Information Systems Engineering	0.00%	0
17	Structural Engineering	0.94%	1
	Total	100%	106

Q7 - If applicable, please select your secondary field of study

#	Answer	%	Count
1	Aerospace Engineering	3.70%	1
2	Architectural Engineering	7.41%	2
3	Biomedical Engineering	0.00%	0
4	Biotechnology Engineering	0.00%	0
5	Chemical Engineering	3.70%	1
6	Civil Engineering	0.00%	0
7	Communication Systems Engineering	3.70%	1
8	Environmental Engineering	11.11%	3
9	Electrical and Computer Engineering	3.70%	1
10	Industrial Engineering	0.00%	0
11	Management Engineering	7.41%	2
12	Materials Engineering	18.52%	5
13	Mechanical Engineering	29.63%	8
14	Robotics Engineering	0.00%	0
15	Software Engineering / Computer Science	0.00%	0
16	Software and Information Systems Engineering	0.00%	0
17	Structural Engineering	11.11%	3
	Total	100%	27

Q8 - How would you rate your academic performance on a scale of 1 to 10 in the following semesters?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Fall 2019 Semester	1.00	10.00	7.65	1.89	3.58	121
2	Spring 2020 Semester	1.00	10.00	6.39	2.46	6.07	120

Q13 - Do you feel you are receiving the same quality of education as you did previously?

#	Answer	%	Count
1	Strongly Disagree	22.95%	28
2	Disagree	35.25%	43
3	Agree	34.43%	42
4	Strongly Agree	7.38%	9
	Total	100%	122

Q14 - Based on the previous question, would you say that your education has changed positively or negatively?

#	Answer	%	Count
1	Negative	49.59%	61
2	Neutral	31.71%	39
3	Positive	18.70%	23
	Total	100%	123

Q9 - Where did you live before the COVID-19 pandemic?

#	Answer	%	Count
1	With Parents or Guardians	14.63%	18
2	Off-Campus Housing	65.85%	81
3	On-Campus Housing	14.63%	18
4	Other	4.88%	6
	Total	100%	123

Q10 - Where were you during spring break or directly after your university's decision to move to remote courses?

#	Answer	%	Count
1	With Parents or Guardians	39.84%	49
2	Off-Campus Housing	47.97%	59
3	On-Campus Housing	3.25%	4
4	On Vacation	8.13%	10
5	Other	0.81%	1
	Total	100%	123

Q11 - Where did you go when campus closed?

#	Answer	%	Count
1	To Parents or Guardians	48.36%	59
2	To Off-Campus Housing	40.98%	50
3	Staying on Campus	3.28%	4
4	On Vacation	0.82%	1
5	Other	6.56%	8
	Total	100%	122

Q12 - How often..

#	Question	0-1 times per week		2-4 times per week		4-6 times per week		greater than 7 times per week		Total
1	did you engage in social activities (any activities with friends) before the COVID-19 pandemic?	19.01%	23	47.93%	58	20.66%	25	12.40%	15	121
2	do you engage in online social activities (any activities with friends) in light of the recent pandemic?	60.66%	74	31.15%	38	4.10%	5	4.10%	5	122

Q15 - As a result of COVID-19, have you experienced a change in your...

#	Question	Decrease		Neutral		Increase		Total
1	level of anxiety?	14.05%	17	38.02%	46	47.93%	58	121
2	level of motivation for academics?	66.67%	80	22.50%	27	10.83%	13	120
3	level of motivation to maintain personal health?	30.00%	36	36.67%	44	33.33%	40	120
4	level of attentiveness in academics?	51.69%	61	35.59%	42	12.71%	15	118

Q16 - Before the pandemic, were you diagnosed with any condition(s) related to mental health?

#	Answer	%	Count
1	Yes	15.97%	19
2	No	84.03%	100
	Total	100%	119

Q17 - Have you noticed any changes in your mental health as the pandemic has progressed?

#	Answer	%	Count
1	Yes	36.67%	44
2	No	63.33%	76
	Total	100%	120

Q19 - How do you feel the pandemic has affected your physical health?

#	Answer	%	Count
1	Negatively	42.62%	52
2	Neutral	41.80%	51
3	Positively	15.57%	19
	Total	100%	122

Q20 - Do you currently have adequate access to what you need to be successful in academics? Examples might include Wi-Fi, workspace, or educational materials.

#	Answer	%	Count
1	Yes	85.83%	103
2	No	14.17%	17
	Total	100%	120

Q22 - Are you experiencing or have you experienced food insecurity during the pandemic?

#	Answer	%	Count
1	Yes	12.40%	15
2	No	87.60%	106
	Total	100%	121

Q23 - Did you have a job (or were going to have one) before the pandemic?

#	Answer	%	Count
1	Yes	51.64%	63
2	No	48.36%	59
	Total	100%	122