

Work in Progress: A Cross-sectional Survey Study for Understanding and Addressing the Needs of Engineering Students During COVID-19

Dr. Isabel Hilliger, Pontificia Universidad Católica de Chile

Isabel Hilliger is the Associate Director for Assessment and Evaluation at the Engineering Education Division in Pontificia Universidad Católica de Chile (UC). Isabel received a PhD in Engineering Sciences from UC and an MA in Education Policy from Stanford University. Her current research promotes the use of methodologies and analytical tools for continuous curriculum improvement in Higher Education. She has created qualitative and quantitative instruments for outcome assessment in engineering education. She has also evaluated policy efforts towards engineering diversity and undergraduate research.

Miss Constanza Melian, Pontificia Universidad Católica de Chile

Constanza Melian is Assessment and Evaluation Coordinator for Division of Engineering Education at Pontificia Universidad Católica de Chile. Constanza is sociologist, interested in issues of education, social inequality, poverty and gender gaps. Methodologically his interests and work is in survey design, construction of quantitative instruments, statistical data analysis and evaluation of social programs.

Miss Javiera Francisca Meza, Pontificia Universidad Católica de Chile

Javiera Meza has a Bachelor of Engineering Science in Pontificia Universidad Católica de Chile. She is a research assistant of the Engineering Education Division, responsible for supporting research tasks and collaborating in data collection and analysis. Javiera developed a project about STEM education focused on primary school. Her research theme is about gender gap and motivation of students in undergraduate computer science programs. Currently she is researching about student motivation in online lessons due to the influence of COVID-19.

Mr. Gonzalo Cortés, Pontificia Universidad Católica de Chile

Gonzalo Cortés is an undergraduate student at the engineering school in Pontificia Universidad Católica de Chile. His Major is Electrical Engineering and his Minor is Energy. Currently, he is a research assistant of the Engineering Education Division, responsible for supporting research tasks and collaborating in data collection and analysis. Gonzalo managed a pre-engineering program to encourage high school students to study careers in engineering and science. He also volunteered as a teacher in communication skills and personal development, aimed at training high school students in vulnerable backgrounds.

Jorge A. Baier, Pontificia Universidad Católica de Chile

He is an associate professor in the Computer Science Department and Associate Dean of Engineering Education at the Engineering School in Pontificia Universidad Católica de Chile. Jorge holds a PhD in Computer Science from the University of Toronto in Canada and a Master's Degree in Engineering Sciences from Pontificia Universidad Católica de Chile. His research focuses on areas of automated reasoning in Artificial Intelligence; specifically, automated planning, search and knowledge representation. Currently his research focuses on understanding how machine learning techniques can be applied to the intelligent decision-making process, on the applicability of AI techniques for enhancing emotional health in Engineering Education. He is also an assistant researcher at the Millennium Institute for Foundational Research on Data.

WIP: A Cross-sectional Survey Study for Understanding the Needs of Engineering Students for Well-being Support during COVID-19

Introduction

This paper presents a Work-In-Progress (WIP) that was carried out in a large engineering school in Latin America. As well as many engineering schools in the U.S. and in other countries [1], [2], this school closed its campus during 2020; therefore, courses had to be delivered through ‘emergency online education’. By emergency online education, researchers have referred to faculty members imparting their lectures in front of a computer screen while students are studying at home [3]. In this context, engineering instructors have used flipped-classroom approaches and take-home resources, so that students could continue learning throughout hands-on activities and team-based projects [2].

Regardless of schools’ efforts to provide continuity of instruction, there is a widely shared concern about the impact of the pandemic on students’ well-being [2], [4]. By not being able to interact with staff and peers regularly, students take the burden of continuing their studies on their own shoulders [4]. This has particularly affected engineering students, who have experienced high levels of stress and time pressure even before the pandemic [5], [6]. Over the past few years, engineering curriculums have been packed with a large number of complex courses and project-oriented assignments [4]. During the pandemic, this intense workload has adversely affected students’ help-seeking behaviors and their capacity to meet deadlines [4].

For understanding how the consequences of this pandemic have affected students’ well-being, some researchers have implemented cross-sectional surveys [4], [7]–[9]. These types of studies are frequently used to measure stakeholders’ needs of support services as they relate to courses, programs or involvement in institutional planning [10]. So far, there is a growing body of knowledge regarding factors that have affected students’ mental health [9], along with scales to measure students’ anxiety levels [11]. However, the pandemic has come with confusing and changing information, making it more difficult for educational institutions to maintain some sense of well-being among their students [12]. Given the close relationship between student well-being and learning outcomes [4], more studies are needed to understand factors that might negatively affect students’ learning experiences.

This paper presents a work in progress that is part of a larger study to monitor students’ needs in the engineering school at Pontificia Universidad Católica de Chile (UC-Engineering). The research question addressed in this study is: *What are the needs for well-being support services in engineering schools from the perspective of students therein?* Specifically, this paper aims to identify students’ needs during the first and the second academic periods in 2020, along with the perceived benefits of having implemented a one-week break. To meet this research objective, we applied two cross-sectional surveys to convenience samples of engineering students: one in June 2020 (N=994) and one in September 2020 (N=1,185). In the following sections, we describe the findings obtained from an analysis of the data collected, besides discussing implications for engineering education settings beyond the current pandemic.

Research design and current data collection

This paper is part of a large survey study to understand students' needs for well-being support services during the outbreak of COVID-19. In order to examine students' perspectives during 2020, two cross-sectional surveys were applied in UC-Engineering: one during the first academic period and another one during the second academic period (see Figure 1). These surveys were designed according to findings from prior evaluations of fall breaks to improve student well-being throughout an academic period [13], [14], in order to collect information regarding student time management, academic workload, and assessment patterns after the break. In student survey 1, we included a 5-point scale to measure students' perceptions regarding the expected benefits of the one-week break (<http://bit.ly/3j68NPf>). In student survey 2, additional questions were formulated by adapting the scales used by Poole et al. [14] to collect further data about students' well-being (<http://bit.ly/3apQL6t>). We tested these questions with two experts in the design of instruments for social research, along with conducting cognitive interviews with two engineering undergraduates by using the think-aloud approach [15].

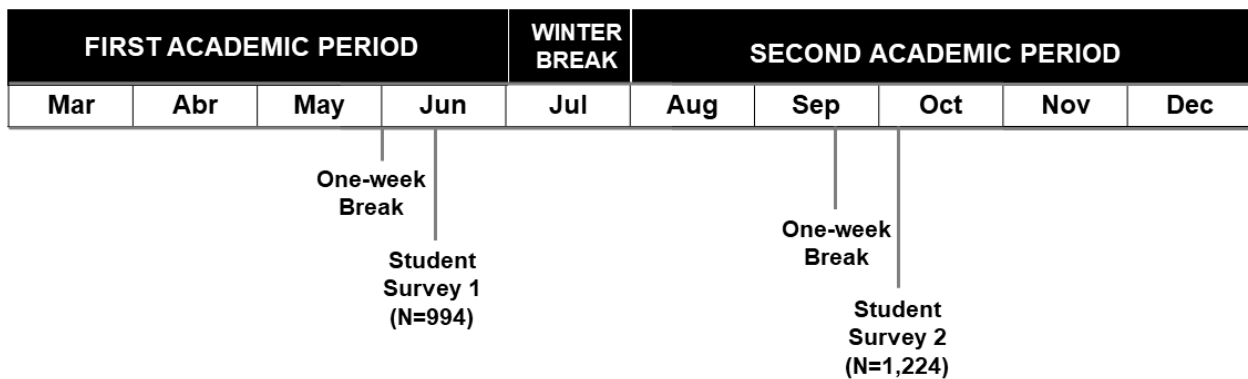


Figure 1. Cross-sectional survey study to understand students' needs for well-being support services during the outbreak of COVID-19 in 2020

Table 1. Distribution of participants in student survey 1 and 2 according to their cohort

Cohort	Student Survey 1 (N=994)	Student Survey 2 (N=1,185)
First-year students (freshmen)	15%	22%
Second-year students (sophomores)	15%	15%
Third-year students (junior)	15%	16%
Fourth year students (senior)	14%	13%
Other (pursuing a professional or graduate degree)	41%	34%

As suggested by Agnew et al. [13], student surveys 1 and 2 were applied immediately the week after the break (first week of June and last week of September). Both surveys were anonymous and applied through a web-based application. They were voluntarily answered by a convenience sample of 994 and 1,185 respectively (out of 5,328 engineering students). Although female students were slightly overrepresented, students from different admission cohorts were evenly distributed in this sample (see Table 1). Besides, both samples managed to be representative of the students of different engineering majors, replicating the distribution of students affiliated with computer science, mechanical engineering, biomedical engineering, operations research, electrical engineering, chemical engineering, and different civil engineering disciplines.

Findings

Two main findings were extracted from responses to student surveys 1 and 2. *The first finding is that the one-week break was perceived to be more beneficial during the first academic period compared to the second period.* In the first student survey, more than 60% of survey respondents indicated that the break was beneficial for catching up on classwork, for dedicating time to rest, and for improving their personal well-being. Besides, more than 50% of them perceived that the workload during the one-week break and the week after was lower than on an average week (see Table 2). However, this decrease in the perceived workload was not observed in the second semester. Table 2 not only shows that a lower percentage of students perceived a lower workload during and after the one-week break, but also that a lower percentage of students agreed with the possibility of implementing the one-week break in future semesters.

Table 2. Perceptions of the one-week break according to Student Survey 1 and 2

	Student Survey 1 (N=994)	Student Survey 2 (N=1,185)
% of students who perceived lower academic workload during the one-week break when comparing to an average week	53%	41%
% of students who perceived lower or equal academic workload the week after the one-week break when comparing to an average week	55%	43%
% of students who agreed or strongly agreed with the idea of implementing a one-week break in future semesters	76%	66%

The second finding of this study is that students need a more balanced academic workload during the academic period, rather than a one-week break. According to the concluding comments in the first student survey, students perceive that the current academic workload does not leave them time to rest, which affects their mental health:

As a personal opinion, I really like the idea of a one-week break. The problem is that — although it helps a lot to rest from the computer (particularly relevant in an online semester)— usually every week is full of things, the week after the break is just as chaotic as any other week (...) The truth is that I like the idea of a one-week break, but perhaps we have to find a way in which students can also rest mentally from everything. Due to the academic workload and the emotional burden of the pandemic, this semester has been really brutal. (Student, Mechanical Engineering Major)

While (the one-week break) was very helpful, if the second semester goes online again, the school should work on the semester schedule. The perceived academic workload is much higher than prior semesters, added to the effects on mental health generated by the current context. It is unfeasible to continue with semesters of this style. I am at the end of my degree, and I feel that I do not have any free minute (...) I feel that I have learned very little by doing everything on short notice. Due to the number of weekly things to do, there is no time to do things in advance. (Student, Engineering Design Major)

In the second student survey, students once again suggested reducing the academic workload throughout the academic periods:

The academic workload should be reduced. Some teachers do not consider that there are classes after their module and they exceed with the recordings; therefore, I spent more time watching them after the class ends. Besides, it is more difficult to study in a group and to assimilate the course content. (Student, Biological Engineering Major)

The school should reduce the workload inside and outside of class. Besides, the type of assessment methods should be redesigned. A lot of courses use mid-terms and exams that are like the ones used in a face-to-face context, what does not make any sense. This simply does not work — and in many cases—it hinders or increases the anxiety towards being evaluated. (Student, Environmental Engineering Major)

Discussion

Previous studies have evaluated the efficacy of a one-week break to improve student well-being [13], [14], [16], revealing that its implementation could help students regain sleep and motivation to complete the academic term by taking some time away from academic responsibilities. However, this WIP shows that a one-week break may not be enough to reduce perceived academic workload during the COVID-19 pandemic. According to comments made in both student surveys, learners have experienced an increase in their academic workload inside and outside of class. This increase in the perceived workload is a result of different causes, including the growing use of videoconferences and recordings to transfer content, the lack of meaningful assessment methods, and the mental health burden caused by the current crisis.

In these lines, this study confirms the need for further interventions to improve engineering students' well-being. These students constantly struggle with their academic workload due to complex courses and intensive project experiences, and this struggle has eventually lead to higher levels of stress [4]. Prior work has shown that students' perceptions of well-being are strongly influenced by the pattern of assessment schedules [14], and that students experience anxiety and stress if there is a dense pattern of assessment immediately after a break [13], [14]. In that sense, this study confirms that students perceive that the current engineering academic load does not leave them time to rest, affecting their mental health.

Future work will focus on assessing other type of support interventions that were implemented during the outbreak of COVID-19. Considering the perceived need for a balance academic load, we also plan to explore ways to improve curriculum planning and assessment patterns in engineering education. During the second semester of 2020, we collected students' self-reports of time-on-task to identify peaks of academic workload in specific weeks and subjects. Further studies will be conducted to understand how these self-reported data could help teaching staff and students reflect about course planning and time management, respectively.

Acknowledgements

This work was supported by CORFO under grant no. 14EN12-26862.

References

- [1] J. Qadir and A. Al-Fuqaha, "A student primer on how to thrive in engineering education during and beyond COVID-19," *Educ. Sci.*, vol. 10, no. 9, pp. 1–22, 2020, doi: 10.3390/educsci10090236.
- [2] C. M. Gonzalez, "Universities Educating From a Distance," *ASME*, 2020. <https://www.asme.org/topics-resources/content/universities-educating-from-a-distance>.
- [3] W. Bao, "COVID -19 and online teaching in higher education: A case study of Peking University," *Hum. Behav. Emerg. Technol.*, vol. 2, no. 2, pp. 113–115, 2020, doi: 10.1002/hbe2.191.
- [4] D. Chadha *et al.*, "Are the kids alright? Exploring students' experiences of support mechanisms to enhance wellbeing on an engineering programme in the UK," *Eur. J. Eng. Educ.*, pp. 1–16, 2020, doi: 10.1080/03043797.2020.1835828.
- [5] A. P. Smith, *Student Workload , Wellbeing and Academic Attainment*. Springer International Publishing, 2019.
- [6] A. Danowitz and K. Beddoes, "Characterizing mental health and wellness in students across engineering disciplines," 2018.
- [7] W. Cao, Z. Fang, G. Hou, M. Han, X. Xu, and J. Dong, "The psychological impact of the COVID-19 epidemic on college students in China," *Psychiatry Res.*, vol. 287, no. March, p. 112934, 2020, doi: 10.1016/j.psychres.2020.112934.
- [8] C. A. Perz, B. A. Lang, and R. Harrington, "Validation of the Fear of COVID-19 Scale in a US College Sample," *Int. J. Ment. Health Addict.*, pp. 1–11, 2020, doi: 10.1007/s11469-020-00356-3.
- [9] C. Son, S. Hegde, A. Smith, and X. Wang, "Effects of COVID-19 on College Students' Mental Health in the United States: Interview Survey Study," *J. Med. Internet Res.*, vol. 22, no. 9, pp. 1–14, 2020, doi: 10.2196/21279.
- [10] J. W. Creswell, *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*, 4th Editio. Boston, Massachusetts: Pearson Education, Inc., 2012.
- [11] Z. L. Duraku and L. Hoxha, "The impact of COVID-19 on higher education: A study of interaction among students' mental health, attitudes toward online learning, study skills, and changes in students' life," 2020.
- [12] IAU, *The Impact of Covid-19 on Higher Education around the World*. 2020.
- [13] M. Agnew, H. Poole, and A. Khan, "Fall break fallout: Exploring student perceptions of the impact of an autumn break on stress," *Student Success*, vol. 10, no. 3, pp. 45–54, 2019, doi: 10.5204/ssj.v10i3.1412.
- [14] H. Poole, A. Khan, and M. Agnew, "One Week, Many Ripples: Measuring the Impacts of the Fall Reading Week on Student Stress," *Collect. Essays Learn. Teach.*, vol. 10, pp. 163–172, 2017, doi: 10.22329/celt.v10i0.4757.
- [15] K. Ryan, N. Gannon-Slater, and M. J. Culbertson, "Improving Survey Methods With Cognitive Interviews in Small- and Medium-Scale Evaluations," *Am. J. Eval.*, vol. 33, no. 3, pp. 414–430, 2012, doi: 10.1177/1098214012441499.
- [16] H. Poole, A. Khan, and M. Agnew, "Stressing in the Fall: Effects of a Fall Break on Undergraduate Students," *Can. J. High. Educ.*, vol. 48, no. 3, pp. 141–164, 2018, doi: 10.7202/1057133ar.