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A first look at resilience in both an HSI and a PWI during the COVID-19 pandemic

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We all have been profoundly impacted by the COVID-19 pandemic. Those of us who work in higher education have been changed by the necessity to work remotely and by the loss of connection with students. We also recognize that we are privileged to have the resources to wonder about the impact of the pandemic, while some among us struggle with financial devastation, mental health crises, and the medical impact of the novel coronavirus. In this paper we provide a first look at resilience among our engineering students and compare the responses from two different institutions.

Researchers in the College of Engineering at California State University, Los Angeles (Cal State LA) and the College of Engineering at California Polytechnic State University, San Luis Obispo (Cal Poly) are in the middle of a broad research study investigating the impact to the members of our college community caused by the COVID-19 pandemic disruption within the framework of resilience. This study has several dimensions that can inform a deeper understanding of resilience and interventions in higher education with an equity lens. The broader study will inquire into resilience over time (via a longitudinal survey), investigate the nature of resilience during the initial shock and ongoing recovery (via interviews), and make comparisons between populations with different ethnic and socioeconomic demographics. The project is based on theories of resilience from both educational and community perspectives and includes consideration of engineering education practices.

This current paper will outline the resiliency framework we are using and report on the first round of results from a survey administered in April of 2020. We will conclude by describing our next steps in the analysis of data collected.

The Two Universities

The two universities participating in this study are institutions in the California State University (CSU) system, with similar undergraduate enrollment: in Fall 2018 Cal State LA at 24,002, and Cal Poly at 21,037. They both are funded with approximately 50% state allocation and 50% tuition, and each has a college of engineering. This is where the similarities end. Cal State LA's college of Engineering, Computer Science and Technology (ECS&T) has 3092 undergraduates in eight majors while Cal Poly's College of Engineering (CENG) is about twice that size with 5921 undergraduates in thirteen majors. The university demographics are also dissimilar with the 2018 data showing that Cal State LA is primarily a commuter school, where 63% of the students are Hispanic, 57% first generation, 5% are white, the first time freshman acceptance rate was 46%, and the Fall 18 admitted class included 36% transfer students. At Cal Poly the population is 16% Hispanic, 10% first generation, 51% white, the first-time freshman acceptance rate is 22%, and the entering class included 15% transfer students. Although the universities are in the same system, the tuition and fees at Cal State LA are $6750/yr while at Cal Poly tuition and fees is $9950/yr. The higher fees provide Cal Poly with more resources that can be used in many ways to support students. An indication of the resource imbalance can be seen in the tenure/tenure-track faculty to student ratio in the engineering colleges: Cal State LA is 59:1 and Cal Poly is 45:1. These differences allow us to compare the responses of employees and students at the two universities with a diversity and equity lens. Cal State LA is classified as a Hispanic Serving Institutions (HSI) while Cal Poly is considered for this study a Predominately White Institution (PWI).

This current study was initiated by Cal State LA where the faculty researchers have been working to support their minoritized students for decades. In particular the college has developed outreach, bridge, and supplemental programs to support persistence and degree completion (Menezes, 2017, 2019). They have also worked across campus to develop faculty professional development activities (Galvan 2020) to support evidence based teaching practices including active learning, flipped classroom, asset-based (Yosso, 2005) and equity minded classroom practices such as mastery grading. One of the successful student based programs, FYrE which is supported with an NSF-IUSE grant (DUE-1727054) emphasizes a cohort based first year experience which highlights a mindset framework (Dweck, 2008). These practices have convinced us that a strong connection to community, asset-based orientation, and flexible mindset all contribute to good outcomes. Although these elements contribute to building resilience in the student population, there are also many challenges related to fewer financial resources and weaker academic preparation.

Cal Poly too has many programs to support student success. Recently the university has put much emphasis into creating a welcoming environment to support people of color and first generation students. The College of Engineering has been a leader in this area. The college has programs such as the Multicultural Engineering Program and Women's' Engineering Program that for decades have worked to build communities to support under-represented groups. Cal Poly, also has an active Office of University Diversity and Inclusion (OUDI) which coordinates many activities using the Collective Impact Framework to align outcomes and activities across campus.

Resilience Framework

Although many agree that resilience is good and important to understand, there is a striking lack of agreement on the definition of this concept, let alone a framework for exploration (Edwards, et al 2016, Consoli, et al 2015, Fernando & Hebert, 2011, Allan et al, 2014, Lee et al, 2013, Carnell et al, 2018). Given this lack of consensus, we want to be explicit about the definition and framework we are using. This framework is informed by past work in resilience and recovery after natural disasters (Rodriguez-Nikl et al, 2015a, Martinez et al. 2018, Rodriguez-Nikl, 2015, Rodriguez-Nikl & Mazari, 2019, Bocchini & Frangopol, 2011, Bochini, et al, 2013, Bruneau, et al 2003, Cimellaro, et al 2010, Zhou et al, 2010), our orientation around an asset-based framework as defined by Yosso's Community Cultural Wealth (Bourdieu, P. & Passeron, J. 1977, Smith, J. M., & Lucena, J. C. 2016, Valenzuela, A. 1999, Yosso, T. J., 2005, Schlemer, 2020, Galvan et al, 2020), our experience in engineering education research (Schlemer & Vanasupa, 2016, Schlemer, 2020, Schlemer et al, 2018, Sharif et al, 2016, Estrada & Schlemer, 2015, Rodriguez-Nikl et al, 2015b) and finally in our ongoing design of support for students (Menezes et al, 2017, 2019, Chen et al, 2018, Schlemer et al, 2018)

Resilience is always referenced in relationship to a negative situation, which can be either chronic and ongoing or acute and solitary. Some refer to these situations as stressors and shocks (Choularton, et al 2015). In the research on resilience in natural disaster recovery, there are two distinct temporal incidences. The first is the onset of the unusual external shock, and the second is the recovery period. The ability to withstand the initial shock is referred to as "robustness" while the ability to recover is "rapidity" (Bocchini et al, 2013). The disaster resilience literature has identified a wide range of factors that determine whether a community will be resilient. These include (with examples relative to this work), infrastructure (computing and internet), financial (wealth and employment), human and cultural (academic family expectation, food security), social (support networks), political (college governance), and the mental outlook of individuals (Patel, et al, 2017, NASEM, 2019).

Resilience has been studied at scales ranging from individuals to broader communities, which highlights both internal and external supporting factors. Internal factors reside inside an individual agent and may be characterized by such psychological traits and skills as optimism, creativity, spirituality, humor, self-efficacy, self-esteem, empathy, cognitive hardiness, internal locus of control, autonomy, and tenacity (Allan et al 2014, Carnell et al 2018, Davis 2010, Edwards et al 2016, Fernando & Herbert 2011, Morgan Consoli et all 2015). External or structural factors include those outside the individual such as social and familial support, material resources, cultural values (Morgan Consoli, et al, 2015, Edwards et al, 2016, Fernando & Herbert, 2011, Allan et al, 2014, NASEM 2019, Patel, 2017). As an example of the difficulties with understanding of resilience, ongoing stressors can either contribute to resilience by strengthening positive coping mechanisms or can detract from resilience by draining the ability to cope.

There are many outcomes that have been attributed to resilience and potential interventions. Some examples are mental and physical health, retention in college, grades, increased in constructs such as self-efficacy, self-esteem, tenacity, hope, and coping. (Carnell et al, 2018, Lee et al 2013, Morgan Consoli, et al, 2015, Edwards et al, 2016, Brewer et al, 2019, Turner 2017, Verdin et al 2018)

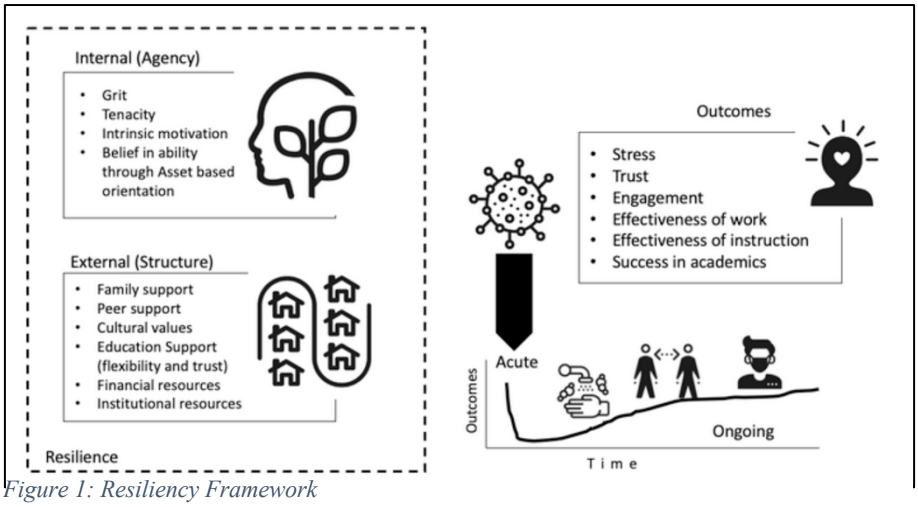


Figure 1: Resiliency Framework

In this study we use the definition of resilience provided by the National Academies: "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events" (National Research Council, 2012). We measure the absorption and recovery aspects with a goal of informing future adaptation and planning. The COVID-19 pandemic can be said to include both acute and ongoing events. We are interested in the acute disruption caused by the rapid shift to remote work and learning due to the pandemic and the ongoing stressors related to coping with ongoing remote

education or returning to campus. Our considered determinants of resilience include both the internal resources of the individual and the external resources available in the individual's environment, which may include family, community, and the institutional environment. It is also our belief that resilience is not a fixed trait, but that it can be enhanced or decreased by interventions in both the internal and external resource set. Figure 1 illustrated the framework for the current study. The concepts include a list of both internal and external resilience factors and outcomes which we inquire into either in the longitudinal survey or the planned interviews and focus groups.

Methods

The survey was reviewed and approved by IRB at both Cal State LA and Cal Poly, SLO. The surveys are administered with an email invite to an online survey in Qualtrics. Although the larger study administered the surveys multiple times, this paper addresses the survey that was sent out on April 15 at Cal State LA and April 21 at Cal Poly. The surveys were sent out on different dates as the Human Subjects approval was needed as each university. The universities are also on a different academic calendar (Cal Poly is on the quarter system and Cal State LA is on the semester system), so the timing was also influenced by this. In the questions, students were asked to consider their responses first before the shift to remote learning (referenced mid-February) and then as of the date of the survey.

Students were asked several questions in order to develop a unique identifier to link future longitudinal responses. For instance, we asked the day of the month of your birthday? (If your birthday is July 4th, then enter 04), Number of older (not younger) siblings (all older brothers and sisters), and several other similar questions. The survey also has logic so that there were different questions during the first time a person took the survey and if the student was in classes or not.

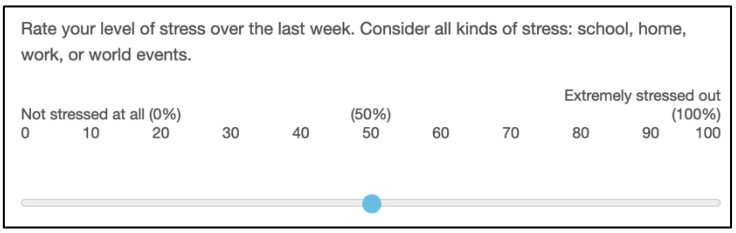


Figure 2: Example of the "slider" question format

The questions were generated with considerable consideration by the research team. We also tested the questions with current students. Most of the questions are asked with a "slider" (see Figure 2) for quantitative responses which allows the use of statistical analysis to measure the significance of differences.

There were several open-ended questions that allowed for more in-depth qualitative analysis. We asked, "What additional help can the college or University provide to you during this time?" and "Is there anything either negative or positive about the stay-at-home situation that you would like to share with us?" The answers to these Open-ended comments were coded and sorted into broad categories.

Results

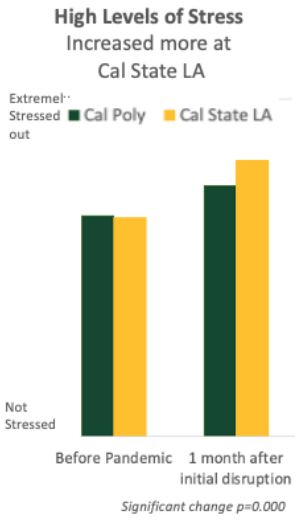


Figure 3: Stress

This paper shares the results from the first round of the longitudinal survey of students where we asked questions about both before and after the immediate shift to remote learning. Many of the results replicate what is already known about the stress our students are facing, but there are also some new insights when comparing the two universities. The results are from 550 students (344 at Cal Poly and 206 at Cal State LA). The demographics of the respondents match the university demographics, with 59% of Cal Poly respondents indicating they are white, while 4% of Cal State LA respondents indicate they are white (see Figure 3). It is also clear from this chart the dramatic differences in the two universities ethnic diversity. For this reason alone, we believe that the comparison of these universities can lead to important insights about interventions and resource allocations.

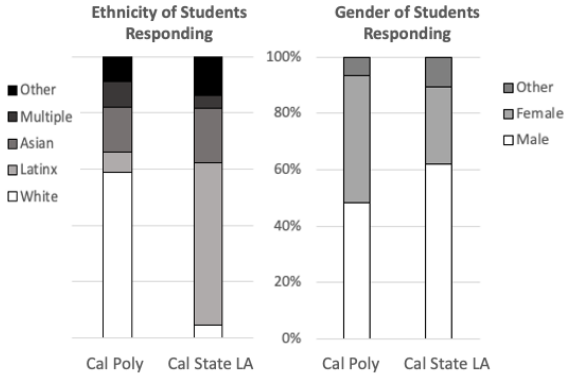
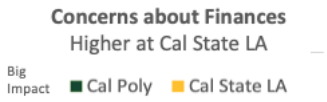


Figure 4: Survey response Demographics

Initially we used a simple paired T-test statistical comparison to find several areas of significant differences. The stress level for engineering students at both universities increased post transition to remote learning. However, students at the Cal State LA indicate their stress increased more (See Figure 4). Given the ethnic differences in the two universities, this result is representative of the disparate impact that the pandemic has had on people of color. When we specifically asked about financial stress, engineering students at both schools reported increased concern, but student in Cal State LA indicated higher levels of concern. (see Figure 5).



We also inquired about instructional effectiveness and pedagogical techniques. The responses to questions about instructor effectiveness and engagement showed an expected significant drop. The drop was similar for both universities. However, there were some interesting results from questions about instructional techniques (see Figure 6). Engineering students after the shift to remote learning indicated that 94% of the instructors at Cal Poly use the Leaning Management System (LMS) while only 78% of the instructors at Cal State LA use the LMS. This might be due to the larger percentage of lecturers or adjuncts who are teaching at the Cal State LA. Since this university is in a large urban area, many of the instructors work full time in industry and thus they are less focused on teaching technology and more focused on content. This seems important because a well-organized and comprehensive LMS supported course can make online instruction effectiveness better and lower stress for students.

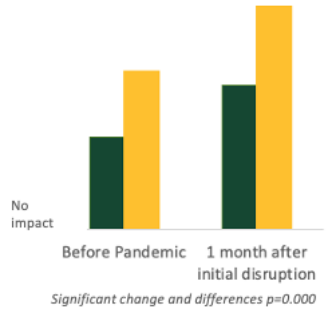


Figure 5: Stress from Finances

Figure 6: Use of LMS

Another interesting contrast is seen in the use of synchronous and asynchronous instructional techniques after the shift to remote learning. At Cal Poly 67% of instructors sometimes used synchronous, and 44% sometimes used asynchronous. At Cal State LA 84% of instructors sometimes used synchronous and 29% used asynchronous (Figure 7). When instruction moved to online, many instructors made a quick switch through zoom lectures. Although connecting with students is possible in a synchronous environment, the technological challenges for some students make real-time zoom lectures difficult. In addition, the instructor unfamiliarity with the technology caused some ineffective sessions. These difficulties are especially hard for students without a resource for high speed internet. This could increase the disparate access to educational resources and barriers for some students.

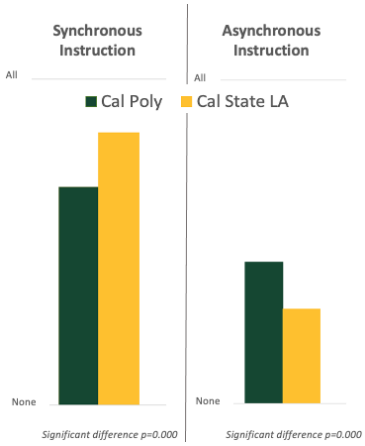


Figure 8: Instruction types

Figure 7: Quiet place to study

Lastly the availability of a quiet place to study was higher for students at Cal Poly (Figure 8). Students from wealthier backgrounds will have access to such things as a desk or office, a printer, and high-speed internet. Again, this amplifies inequities differences in grades, pass rates and longer time to graduation.

There were several open-ended questions for students to indicate ways in which they were in need of support or areas of concern for them. These comments were coded and sorted by topic area. The following graphic indicates the count of the types of comments. Also included is an example of a comment in each category. These illustrate the heartbreaking difficulties that the students are dealing with as they adjust to the pandemic.

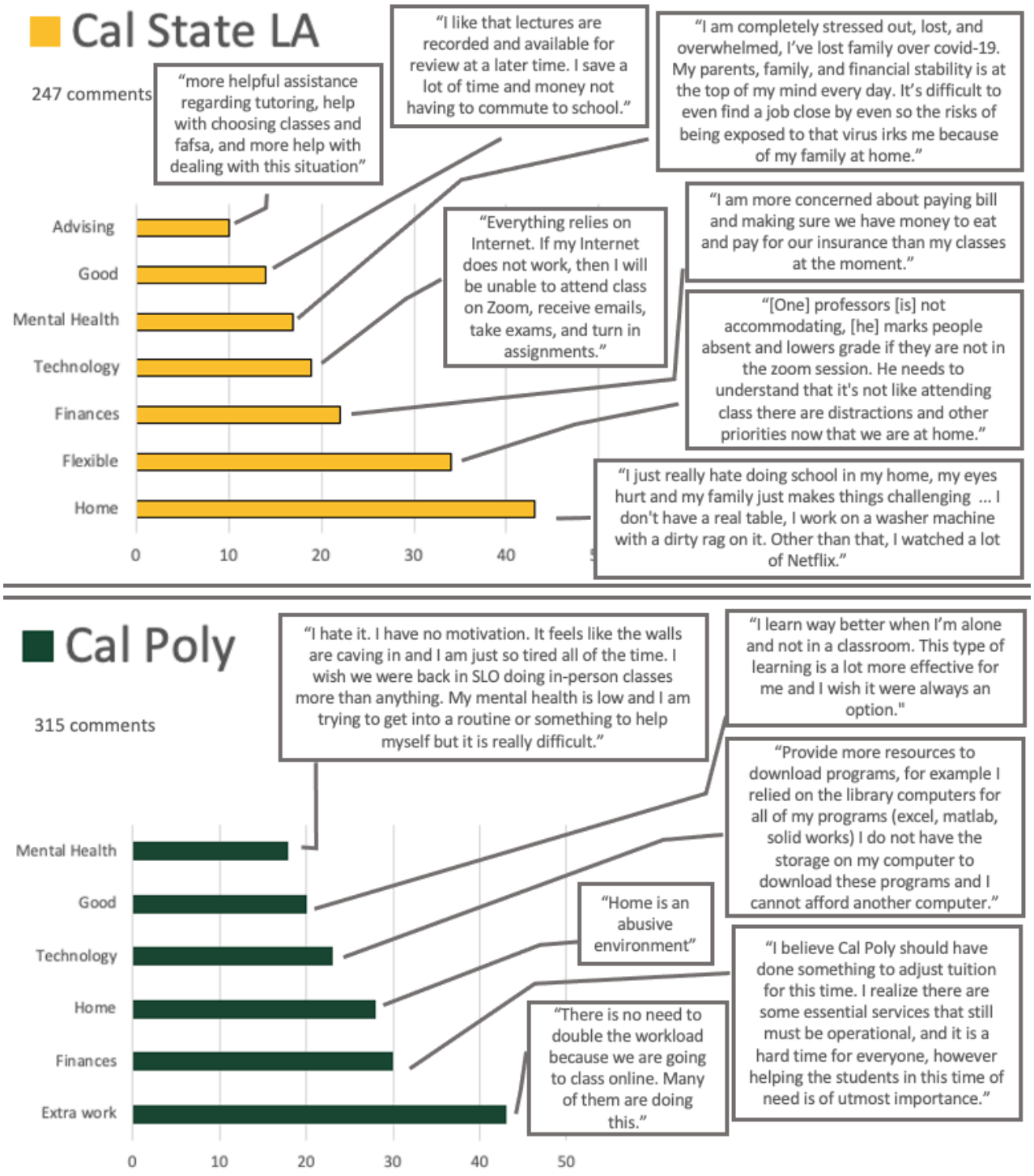


Figure 9: Qualitative analysis

Conclusions and Net Steps

The data collected through this survey reinforces what many other research projects and antidotal stories have found regarding the shift to remote learning. The survey validated increased level of stress and specifically financial stress for engineering students. The shift caused difficulty in learning for students at both universities where they report lower effectiveness and lower engagement overall. In addition, this survey shows the disparate impact on students from lower social economic status and people of color. The increased stress has been universal, but the extra worries associated with

increased exposure to COVID-19, the loss of employment in the service economies which also have lower pay, and the lack of technology or suitable places to study all fall more heavily on students from the urban Hispanic Service Institution (HSI) than from the Predominately White Institution (PWI). Lastly the use of instructional techniques is not equal across the universities. Cal State LA students not only have the difficulties related to lack of resources and systemic inequities, but they also have to cope with less effective instructional techniques.

As we continue this research it is our goal is to begin to understand the assets our students have and the systemic hardships they face during this pandemic in order to develop interventions and support systems in the universities that will increase student success and well-being.

We also will continue to analyze the longitudinal data using advanced analysis techniques. The data will be used to model the influence of the variables studied on the quality of learning. The modeling effort will lead to an improved understanding of organizational dynamics and help inform strategic decisions to improve and sustain the educational mission. These results will likely highlight other differences between the two institutions to enrichen our understanding of equity considerations. In the model, the performance of each institution is represented by the effectiveness of instruction, student performance, and student engagement. These variables depend, in turn, on other variables according to the causal relations hypothesized in Figure 10. The strength of these causal relations will be determined by structural equation modeling. This process will yield a model for the organizational dynamics of each institution. The resulting model can be used to identify variables that are most important for the educational mission, i.e., those that have the most significant influence on the output measures and also those that help minimize the influence of external disruptions.

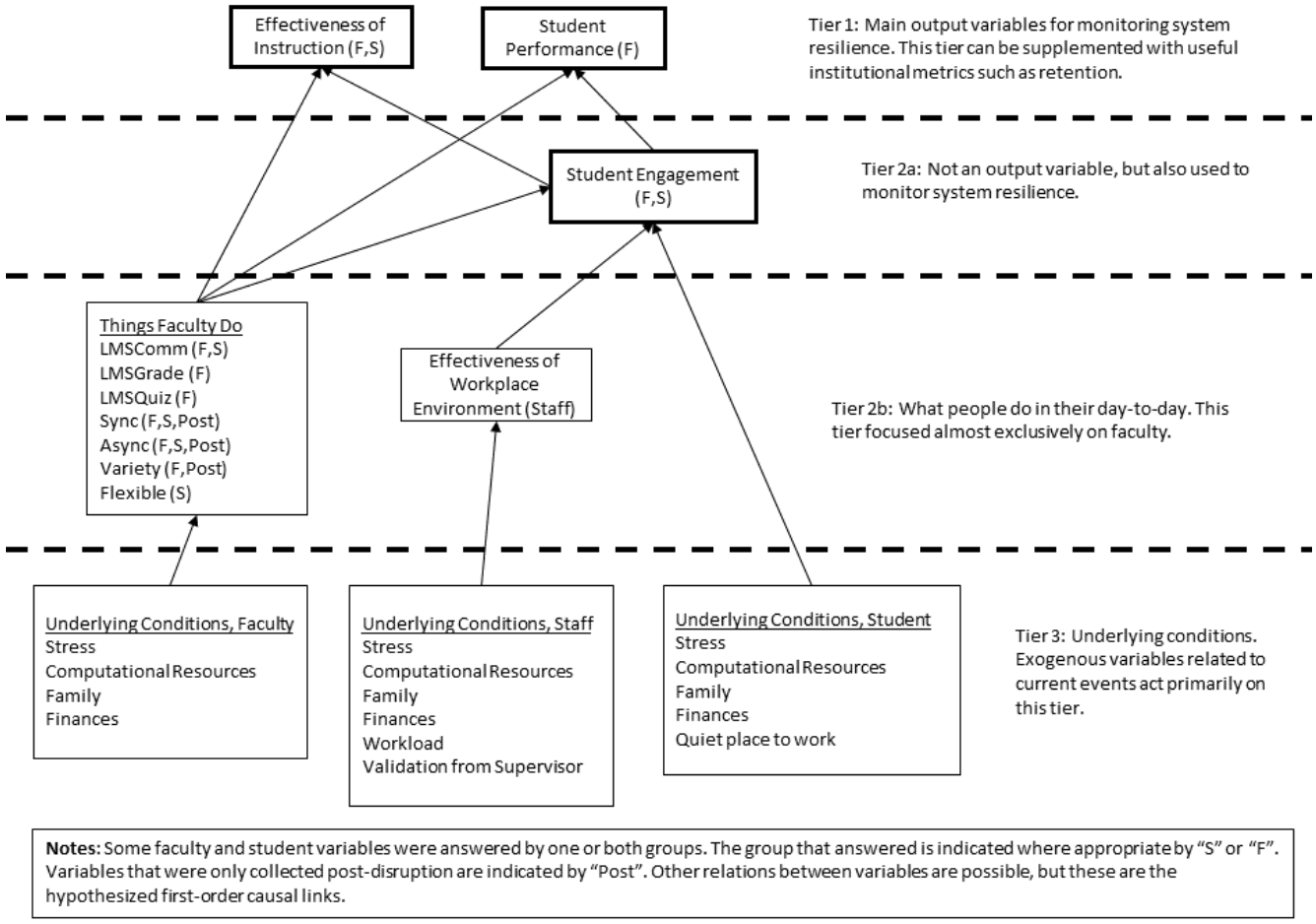


Figure 10: Causal Relationship Framework

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