

## **Characterizing Mental Health and Wellness in Students Across Engineering Disciplines**

**Dr. Andrew Danowitz, California Polytechnic State University, San Luis Obispo**

Andrew Danowitz received his PhD in Electrical Engineering from Stanford University in 2014, and is currently an Assistant Professor of Computer Engineering at California Polytechnic State University in San Luis Obispo. His engineering education interests include student mental health, retention, and motivation.

**Dr. Kacey Beddoes, University of Massachusetts, Lowell**

Kacey Beddoes is an Assistant Professor in the Department of Sociology at the University of Massachusetts Lowell. She received her Ph.D. in Science and Technology Studies (STS) from Virginia Tech, along with graduate certificates in Women's and Gender Studies and Engineering Education. Dr. Beddoes serves as Deputy Editor of the journal *Engineering Studies* and as Chair of the SEFI Working Group on Gender and Diversity. Further information can be found on her website: [www.sociologyofengineering.org](http://www.sociologyofengineering.org)

## **Abstract**

Anecdotal evidence has long supported the idea that engineering students have lower levels of mental health and wellness than their peers. It is often posited that the large number of courses, low overall retention, difficult courses, and the abundance of intensive engineering projects lead to an unhealthy work-life balance and eventually lower levels of mental health for this population. To date, however, there has been no comprehensive study on the prevalence and types of mental health conditions that afflict engineering students, or any data on whether certain disciplines within engineering may see a greater prevalence of certain mental health conditions among students than other disciplines.

This paper presents the results of a one-year study performed at California Polytechnic State University to address the knowledge gap surrounding mental health across students in different engineering disciplines in higher education. For this study, the authors developed and administered a comprehensive mental health questionnaire to both undergraduate and graduate students across eleven different engineering disciplines. The instrument screens for likelihood of depression, anxiety, PTSD, drug abuse, alcohol abuse, and other major mental illnesses. An analysis of the data shows that while mental health and wellness issues are prevalent across all majors, specific disciplines appear to have very different mixes of conditions and issues affecting their students.

## **Introduction**

Mental wellness issues are becoming increasingly prominent on college campuses (Flatt, 2013; Gallagher, 2008; Ladeji-Osias & Wells, 2014; Kitzrow, 2003; Wood, 2012). Suicide is the second leading cause of death among college students (Taub & Thompson, 2013), and the numbers of students dealing with depression and suicidal thoughts are increasing (Gallagher, 2008). Many universities struggle and are unable to meet the needs of the increased demand for mental health services: counseling centers are overburdened and some have labeled the situation a “mental health crisis” (Flatt, 2013; Wood, 2012). Despite engineering’s reputation as one of the toughest and most stressful fields of study, however, and despite its chronically low retention rate, research on mental wellness issues specific to engineering students is remarkably scarce.

This paper attempts to address this knowledge gap by presenting results from a one-year mental health study performed at California Polytechnic State University (Cal Poly). Relying on standard, pre-validated survey instruments, this study measures the prevalence of mental wellness conditions including depression, anxiety, PTSD, and drug and alcohol abuse among undergraduate and master’s students from nine different engineering departments and programs. The data presented here shows the prevalence of these conditions in the student population, with roughly 38% of respondents screening for high risk of Serious Mental Illness (SMI) (as indicated by the Kessler 6 instrument (Kessler, et al., 2002)), and gives a view of how the prevalence of these conditions varies across major.

The rest of the paper is organized as follows. First, the Background section briefly discusses previous research performed in the area of mental health in Engineering Education. Second, the Study Design section discusses the survey instruments selected for this study and discusses how the study was administered. The Analysis section discusses the resulting data. Finally, the paper concludes with a discussion of the data and implications for future work.

## **Background**

To the knowledge of the authors, no comprehensive population studies have been performed on mental health in engineering students. A few studies, however, have started to touch on this subject.

In one set of studies, researchers looked at the effects Service Learning on overall mental wellness in Engineering (Paterson, Swan, & Guzak, 2012; Swan, Paterson, & Hellickson, 2014; Swan C. , Paterson, Pierrakos, Bielefeldt, & Striebig, 2011). Other studies have explored how students with certain chronic mental wellness conditions, such as ADHD, fare in engineering programs (Esmaili Zaghi, Tehranipoor, & O'Brien, 2016). Additionally, two other previous studies looked into the prevalence of specific mental health concerns for engineering students. In one, a survey of 582 male engineering students revealed that more than 44% exhibited some symptoms of depression (Goodwin, 2008). In the other, Foster and Spencer (2003) found female engineering students were significantly more likely to have high stress than male engineering students and have higher mean stress loads. While these studies contribute valuable information about certain aspects of mental health in engineering students, they do not give a population-wide view of how engineering students are doing. The work presented here builds off of the foundations laid by these studies, and attempts to get a clearer picture of the prevalence of a variety of conditions afflicting our students.

## **Study Design**

The goal of this study was to get comprehensive baseline data of mental health in engineering students. To reach a broad audience, we designed the study so that it could be administered over an online survey platform. To ensure a high quality of results, we built our instrument as a compilation of pre-verified mental health surveys. While some complete survey solutions already exist for measuring mental wellness in college students, such as the American College Health Association - National College Health Assessment II (ACHA-NCHA II), issues such as proprietary licenses and instrument length led us to develop our study from smaller, open survey instruments.

The first survey included in our instrument is the Patient Health Questionnaire (PHQ). This survey is designed to determine whether a respondent likely suffers from depression, anxiety, or somatoform disorders (Spitzer, Kroenke, Williams, & Group, 1999). Portions of the PHQ have previously been used to measure mental wellness among students in higher education (Zivin, Eisenberg, Gollust, & Golberstein, 2009), making it a safe instrument for inclusion. The PHQ also asks respondents about some potentially risky behaviors which may be symptomatic of underlying mental health issues, such as alcohol abuse and eating disorders.

While the PHQ is able to measure the prevalence of specific conditions, it does not give a sense of overall mental health. For that, we include the Kessler survey instrument. The Kessler surveys are 6 and 10 question survey instruments respectively designed to measure non-specific psychological distress in individuals and identify individuals at high risk of suffering from Serious Mental Illness (Kessler, et al., 2002). The benefits of the Kessler instrument include brevity (6-10 questions), widespread use, and validation, as well as appropriateness across major sociodemographic groups.

The CAGE-AID survey was used to measure the prevalence of substance abuse among respondents. The survey screens for all types of substance abuse (both drugs and alcohol) in a simple 4 question format (Brown & Rounds, 1994), giving a clearer picture of the prevalence of substance abuse engaged in by engineering students.

To test for the prevalence of Post-Traumatic Stress Disorder (PTSD) among students who are veterans and survivors of other traumatic events, we selected the Primary Care – Post-traumatic Stress Disorder (PC-PTSD) survey (Cameron & Gusman, 2003). This instrument consists of 4 yes/no questions and was developed by the Veteran Affairs Administration (VA) to screen for the likelihood of PTSD in veterans. The instrument has since been validated in several civilian PTSD applications (Hegel, et al., 2006; Van Dam, Ehring, Vedel, & Emmelkamp, 2010). While originally designed for use in primary care, this instrument has since been used in self-report survey form (Khaylis, Polusny, Erbes, Gewirtz, & Rath, 2011), making it appropriate for inclusion in our study.

To administer the survey, questions from the above instruments were combined with basic demographic questions into a single instrument hosted on the research.net survey platform (SurveyMonkey, 2017). No personally identifying information was requested; however, we entered into a business associate agreement (BAA) with research.net to ensure that collected survey data was held at a HIPAA-complaint level of security. A link to the survey was emailed to all students in the College of Engineering through its student mailing list at the start of Winter quarter 2017. The survey was additionally advertised through flyers posted within each engineering department. Flyers contained QR-codes and tear-off slips with shortened survey links for easy student access. The survey was officially closed at the start of Spring quarter 2017.

## **Analysis**

Student response to the survey far exceeded expectations. Even without a reminder email or incentives for participation, we received over 900 raw responses.

Survey respondents who supplied clearly spurious responses (for example, selecting “other” and entering “bird person” for every question with a fill-in option), those who selected “decline to participate” for the overall survey, and those who did not complete any screening instruments were excluded from further analysis. This left us with roughly 800 qualified participants, or 16% of the Cal Poly engineering student population. 13% of respondents reported having been previously diagnosed with a mental health condition, and 11% reported that they were in active treatment for a mental health condition at the time of taking the survey. 96% of respondents are undergraduates, while the remaining 4% are from Master’s programs.

A demographic breakdown of respondents is shown in Tables 1-4. To avoid the possibility of singling out or stigmatizing any one population, a breakdown of mental health results by demographic is not included in this publication.

Table 1. Respondent's year in program.

Year in Program	Percent of Respondents
1	23%
2	23%
3	25%
4	19%
5	8%
6	2%

Table 2. Percentage of respondents identifying with each race or ethnicity.

<b>Identity</b>	<b>Percent of Respondents</b>
White	64%
Asian	14%
Hispanic or Latino	11%
Multiracial	4.8%
Pacific Islander	0.75%
Black or African American	0.38%
Middle Easter	0.38%
American Indian, Native Alaskan, or Native	0.38%
Prefer not to respond	4.0%

Table 3. Gender identity of respondents.

<b>Identity</b>	<b>Percent of Respondents</b>
Male	58.6%
Female	40.2%
Nonbinary or Transgender	0.88%
Prefer not to respond	0.38%

Table 4. Sexual identity of respondents

<b>Identity</b>	<b>Percent of Respondents</b>
Heterosexual	87.4%
Gay	5.4%
Bisexual	1.9%
Questioning or unsure	1.0%
Lesbian	0.62%
Other	1.1%
Prefer not to respond	2.0%

The breakdown of respondents by race or ethnicity and gender aligns reasonably well with Cal Poly’s overall student enrollment statistics (California Polytechnic State University, 2018), indicating that we were able to obtain a representative sample of the student body.

The mental health results of the survey for all qualified respondents are shown in Figure 1. As a condition of IRB approval, we were unable to require responses to any individual questions, leading to a situation where some respondents left certain survey instruments partially or fully incomplete. For each respondent, we include results from all fully completed instruments. Also, if we were able to obtain a result from a partially completed survey instrument (e.g. the missing responses could not affect the outcome), we also include the result in the analysis. This methodology means that the number of respondents, N, varied for each measure.

## PERCENT OF RESPONDENTS SCREENING POSITIVE FOR EACH MEASURE

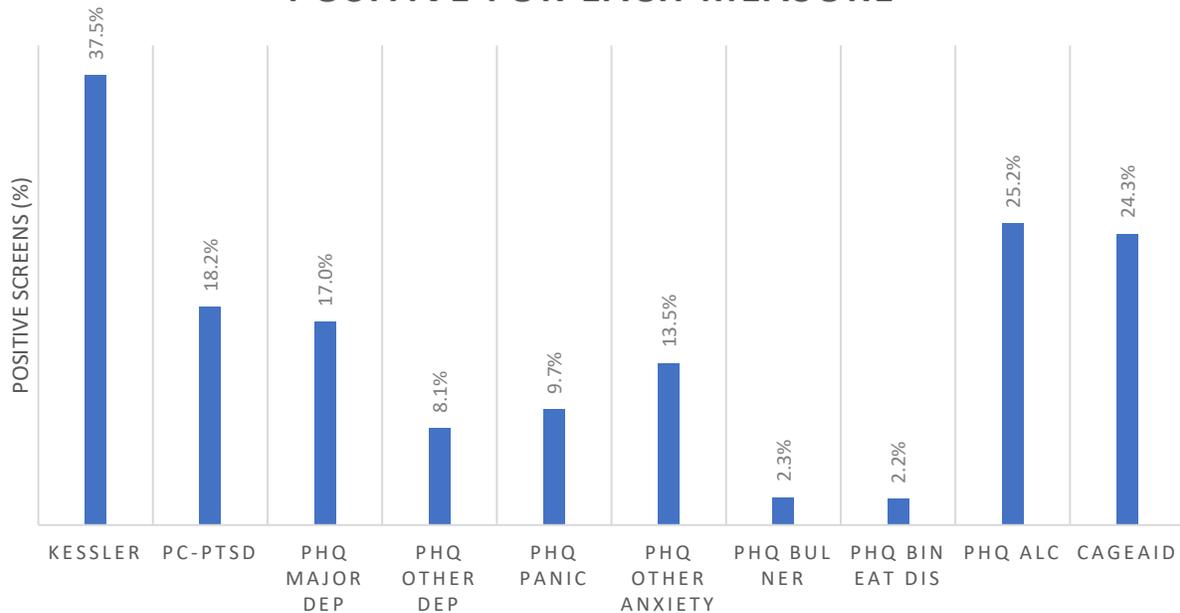


Figure 1. Percentage of respondents with a positive screen to each survey measure. *N*s as follows. Kessler: 794, PC-PTSD: 704, PHQ Dep: 719, PHQ Panic: 724, PHQ Anxiety: 726, PHQ Bulimia Nervosa: 729, PHQ Binary Eating Disorder: 729, PHQ Alcohol: 727, CageAID: 675

The Kessler scale indicates that roughly 38% of respondents screen for high risk of Serious Mental Illness. This is roughly an order of magnitude more than the reported 4% of the U.S. adult population estimated to suffer from a Serious Mental Illness, and more than double the 17.9% of adults estimated to suffer from any mental health condition overall (Center for Behavioral Health Statistics and Quality, 2016). While these numbers do not establish any sort of causality, they do indicate that engineering students in general have higher need for mental health services than the general population. Unfortunately, the authors were unable to find comparable peer-reviewed Serious Mental Illness numbers for the general college population, so it is unclear how engineering students compare to their non-engineer peers in this regard.

Delving into specific mental health and wellness conditions, roughly a quarter of respondents screen positive for some form of depression (PHQ Major + PHQ Other Depression), while a similar percentage of respondents screen positive for some form of panic or anxiety disorder (PHQ Panic + PHQ Other Anxiety). These numbers are more than double the 10.62% rate for mood disorders (including depressive and bi-polar) and 11.94% rate for any anxiety disorder measured in the general college student population (Blanco, et al., 2008). Finally, the number of respondents screening positively for PTSD is roughly double other reported rates for college students (Read, Ouimette, White, Colder, & Farrow, 2011). These numbers strongly indicate that engineering students, or at least those at Cal Poly, have much greater need of mental health services in these areas than the average college student.

While these numbers are significant, it is important to note that engineering is a very broad field with many sub-disciplines and a wide range of students. It is therefore important to compare whether mental health and wellness vary across engineering sub-disciplines. These data are shown in Figure 2.

## Positive Mental Health Screens by Major

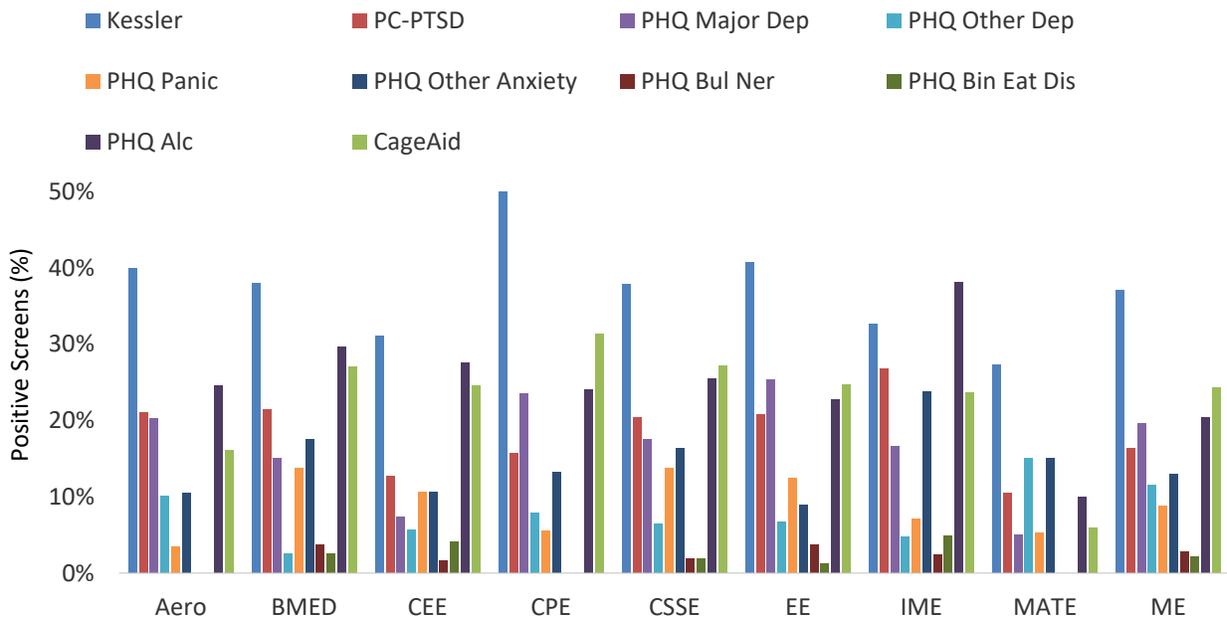


Figure 2. Mental health screenings by major. Aero: Aerospace, N=56-65; BMED: Biomedical, N=74-87; CEE: Civil and Environmental, N=118-132; CPE: Computer Engineering, N=51-60; CSSE: Computer Science and Software Engineering, N=103-119; EE: Electrical Engineering, N=73-86; IME: Industrial and Manufacturing, N=38-46; MATE: Materials Engineering, N=17-22; ME: Mechanical Engineering, N=132-151.

According to these numbers, Computer Engineering (CPE) students are at the highest risk for serious mental illness as measured by the Kessler instrument. This is particularly of note since at Cal Poly, Computer Engineering is a program jointly offered between Electrical Engineering and Computer Science, with a curriculum made up of roughly an even split of courses already offered by the two home departments. It bears further study to determine whether the high Kessler readings for CPEs result from the program's unique identity (no home department or dedicated faculty, and only orientation and capstone courses are unique to the program), the stress from combining courses from two majors that already suffer from high percentages of positive Kessler screens (EE and CSSE), or if this comes from another cause altogether.

While individual majors fluctuate on the percentage of respondents screening positive for each condition, it appears that students from each major have higher rates of SMI than the average U.S. adult population. Also, while some majors screen near the college population average for single measures (mood disorder, anxiety, or PTSD), each major also scores well above the college average on at least one of these measures.

As a side note, the data also illustrate an interesting relationship between the PHQ Alcohol screening numbers and the CAGE-AID screening numbers. Since CAGE-AID is designed to record both drug and alcohol problems, our initial hypothesis was that the number of CAGE-AID screens would be greater than or equal to the number of PHQ Alcohol screens. For Aero, BMED, CEE, and IME, however, there were more positive PHQ Alcohol screens than CAGE-AID.

One potential cause for this may be how each instrument looks for substance abuse. The PHQ Alcohol instrument primarily asks respondents about their personal behaviors related to excess alcohol

consumption—“You drank alcohol, were high from alcohol, or hung over while you were working, going to school, or taking care of children or other responsibilities”— to determine whether the respondent has an alcohol problem. The CAGE-AID, however, asks respondents about their own and their peers’ *attitudes* towards their substance—“Have people annoyed you by criticizing your drinking or drug use.” If there is a permissive attitude towards drug and alcohol use and abuse among students, the CAGE-AID instrument may underestimate the severity of the problem. In the absence of additional data or qualitative interview information, however, it is impossible to say with any certainty where this discrepancy comes from.

## Conclusions

This study looked at incidence of mental health and wellness issues for Engineering students at Cal Poly. The study was composed from several pre-verified survey instruments designed to screen for a number of different mental health issues. Ultimately, we received roughly 800 usable survey responses from a wide spectrum of engineering majors.

The results of the study showed that our engineering students suffer from certain mental health issues at a much higher rate than the average U.S. college student. Our students are roughly 2 times more likely to suffer from some form of depression, anxiety, and PTSD-like symptoms than the average college population. Also, roughly 38% of our students are at risk for Serious Mental Illness according to the Kessler survey instrument.

These results, however, are by no means conclusive, and there are a variety of reasons why our students may have screened positive for these conditions at such a high rate. One possible explanation for these results is that, without prize incentives for participants, the survey may have predominantly appealed to students looking for an outlet to discuss unmet mental health needs. Considering that only 16% percent of our engineering student population responded to the survey, this type of student could have greatly skewed the result.

Additionally, these results may simply be a result of Cal Poly-specific engineering culture where many students pursue part-time work and club-based work in addition to a heavy project-oriented course-load. Therefore, these results may not be completely generalizable to engineering student populations at other institutions.

Even if engineering students do suffer mental health issues at a higher rate than their non-engineering peers, there is also no indication here that these results are caused by engineering programs themselves. It is entirely possible that students who are prone to certain mental health conditions are statistically more likely to be attracted to engineering fields than other courses of studies.

Given the magnitude of engineering students screening positive for mental health conditions, however, this is not a problem that can be completely written off. Instead, the results presented here point to the need for further in-depth, multi-institution studies to determine the extent of mental health and wellness issues in engineering programs nation-wide, and how engineering programs can best serve their students’ mental health and wellness needs. We are in the process of seeking funding to conduct such a nation-wide study.

## References

- Blanco, C., Okuda, M., Wright, C., Hasin, D. S., Grant, B. F., Liu, S.-M., & Olfson, M. (2008). Mental Health of College Students and Their Non-College-Attending Peers Results From the National Epidemiologic Study on Alcohol and Related Conditions. *Archives of General Psychology*, 65(12), 1429-1437.
- Brown, R. L., & Rounds, L. A. (1994). Conjoint screening questionnaires for alcohol and other drug abuse: criterion validity in a primary care practice. *Wisconsin medical journal*, 135-140.
- California Polytechnic State University. (2018, February 10). *Cal Poly Demographics*. Retrieved from Cal Poly Office of University Diversity and Inclusion: <https://diversity.calpoly.edu/cal-poly-demographics-0>
- Cameron, R. P., & Gusman, D. (2003). The primary care PTSD screen (PC-PTSD): development and operating characteristics. *Primary Care Psychiatry*, 9(1), 9-14.
- Center for Behavioral Health Statistics and Quality. (2016). *Key substance use and mental health indicators in the United States: Results from the 2015 National Survey on Drug Use and Health*. Substance Abuse and Mental Health Services Administration. HHS.
- Esmaili Zaghi, A., Tehranipoor, M., & O'Brien, C. (2016). Major Observations from a Specialized REU Program for Engineering Students with ADHD. *2016 ASEE Annual Conference & Exposition*. New Orleans: ASEE.
- Flatt, A. K. (2013). A Suffering Generation: Six factors contributing to the mental health crisis in North American higher education. *College Quarterly*.
- Foster, C., & Spencer, L. (2003). Are undergraduate engineering students at greater risk for heart disease than other undergraduate students? *Journal of Engineering Education*, 92(1), 73-77.
- Gallagher, R. P. (2008). *National Survey of Counseling Center Directors*. The American College Counseling Association.
- Goodwin, M. E. (2008). The Impact of Help Seeking Attitudes and Depression Students' Academic Success. In *Gender role conflict, depression, and personality's effect on help seeking behaviors, attitudes, and academic performance* (pp. 77-105). Iowa State University.
- Hegel, M. T., Moore, C. P., Collins, E. D., Kearing, S., Gillock, K. L., Riggs, R. L., . . . Ahles, T. A. (2006). Distress, psychiatric syndromes, and impairment of function in women with newly diagnosed breast cancer. *Cancer*, 107(12), 2924-2931.
- Kessler, R. C., Andrews, G., Colpe, L. J., Hiripi, E., Mroczek, D. K., Normand, S.-L. T., . . . Zaslavsky, A. M. (2002). Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological medicine*, 959-976.
- Khaylis, A., Polusny, M. A., Erbes, C. R., Gewirtz, A., & Rath, M. (2011). Posttraumatic stress, family adjustment, and treatment preferences among National Guard soldiers deployed to OEF/OIF. *Military Medicine*, 176(2), 126-131.
- Kitzrow, M. A. (2003). The mental health needs of today's college students: Challenges and recommendations. *Journal of Student Affairs Research and Practice*, 167-181.
- Ladeji-Osias, J. O., & Wells, A. M. (2014). Best Practices in Classroom Management for Today's University Environment. *121st ASEE Annual Conference & Exposition*. Indianapolis: ASEE.

- Paterson, K., Swan, C., & Guzak, K. (2012). Impacts of Service on Engineering Students. *2012 ASEE Annual Conference & Exposition*. San Antonio: ASEE.
- Read, J. P., Ouimette, P., White, J., Colder, C., & Farrow, S. (2011). Rates of DSM-IV-TR trauma exposure and posttraumatic stress disorder among newly matriculated college students. *Psychological Trauma: Theory, Research, Practice, and Policy*, 3(2), 148.
- Spitzer, R. L., Kroenke, K., Williams, J. B., & Group, P. H. (1999). Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. *Jama*, 1737-1744.
- SurveyMonkey. (2017). Retrieved from White Label Online Survey Software | Research.net: <https://www.research.net/>
- Swan, C., Paterson, K., & Hellickson, T. (2014). Engineering Pathways Study: Lessons Learned in Its Development and Implementation. *2014 ASEE Annual Conference & Exposition*. Indianapolis: ASEE.
- Swan, C., Paterson, K., Pierrakos, O., Bielefeldt, A., & Striebig, B. (2011). ISES: A Longitudinal Study to Measure the Impacts of Service on Engineering Students. *2011 ASEE Annual Conference & Exposition*. Vancouver: ASEE.
- Taub, D. J., & Thompson, J. (2013). College student suicide. *New directions for student services*, 2013(141), 5-14.
- Van Dam, D., Ehring, T., Vedel, E., & Emmelkamp, P. M. (2010). Validation of the Primary Care Posttraumatic Stress Disorder screening questionnaire (PC-PTSD) in civilian substance use disorder patients. *Journal of substance abuse treatment*, 39(2), 105-113.
- Wood, M. (2012). The state of mental health on college campuses. *Inquiry: The Journal of the Virginia Community Colleges*, 17(1), 5-15.
- Zivin, K., Eisenberg, D., Gollust, S. E., & Golberstein, E. (2009). Persistence of mental health problems and needs in a college student population. *Journal of affective disorders*, 180-185.