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Finding Balance: Examining the Impact of Grades on Engineering Students Well-Being

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Finding Balance: Examining the Impact of Grades on Engineering Students Well-Being

The authors conducted a preliminary research study to understand the emotional and academic impact grades have on engineering undergraduate students. Grades in higher education have become a priority for students to secure internship opportunities, post-graduation employment, and graduate school acceptance. However, students' desire to attain high grades in engineering disciplines may lead to negative psychosocial effects such as additional anxiety and increased mental exertion, physical exhaustion, and overall lack of work-life balance. A survey was conducted with a cohort of 45 students enrolled in a prerequisite, introductory engineering course to understand their perspective on grades before, during, and at the end of the semester, and their responses to obtaining low grades and exam scores. Preliminary results reveal that 60% of the student population expressed anxiety about their grades before the semester began, 64% check their grades at least twice a week via online sources, 96% expressed concern if their grades are not what they expect by mid-semester, 88% mentioned that they memorize material just to pass an assignment. Moreover, other students expressed frustration, disappointment, and high anxiety when they do not attain the grades they want. These findings are imperative and require significant attention since they may affect student learning, retention of fundamental engineering principles, persistence in engineering programs, and overall student well-being.

I. BACKGROUND AND MOTIVATION

For most students, higher education is a pathway to financial security, social mobility, and overall life satisfaction. As such, graduating from college is the primary objective of entering freshmen. Completing an undergraduate degree not only represents a personal achievement, but it also warrants multiple opportunities such as securing employment post-graduation or attending graduate school. However, these personal and academic milestones are not simply attained by completing the intended curriculum. A large number of students, particularly those pursuing STEM fields, engage in various types of co-curricular activities in order to enhance their formal learning experience, deepen their technical skills, acquire relevant, real-world experience, and strengthen their professional competence. A common method of obtaining these types of outcomes, for instance, are in the form of student internship positions. Most engineering students target at least one internship position during their undergraduate tenure, which increases the likelihood of employment post-graduation.

Others engage in research opportunities as an alternative venue towards nurturing academic development [5], [6]. Studies reveal that the number of STEM undergraduate students conducting research is significantly high given its immediate and long-term benefit [1], [4], [5]. In a survey conducted by the National Science Foundation (NSF), 83% of its respondents, which held undergraduate research positions, expressed greater confidence in research and professional abilities, 88% reported significant growth in structuring and conducting a research project, and 73% attested awareness of a graduate school environment [2], [3], [7]. According to Hurtado *et al.* [1], these undergraduate research opportunities have further facilitated the decision of pursuing STEM careers and Ph.D. studies post-graduation [5].

However, experiencing success, such as procuring an internship position, joining an undergraduate research laboratory, or being able to attend graduate school, highly depends on maintaining a competitive grade-point average (GPA). Grades in higher education are of great value since they influence multiple variables and dictate the success of students during matriculation and post-graduation. The risk of meeting such critical demand, nonetheless, can have a short-term or long-term emotional impact on student behavior. Singh and Jha, for instance, reported that depression, a sense of apprehension, and anticipating the worst are the various emotional effects that surround student behavior when grade expectations are not met [13].

Students' desire to attain high grades in engineering disciplines may additionally lead to negative effects such as anxiety, increased mental exertion, physical exhaustion, and overall lack of work-life balance. According to Spielberger, anxiety is defined as a psychological and physical response to a self-concept that is characterized by subjective, consciously perceived feelings of tension [16], [17]. In a study conducted at Cornell University, Schneider reported that 62% of engineering students experienced anxiety over grades due to difficulty of the curriculum, prolonged study hours, non-encouraging faculty, cultural and minority issues, expectation, and financial hardship [13], [14], [15], [18]. Numerous research efforts have simultaneously centralized on assessing test anxiety due to its relationship with performance measures [19]. Hembree, for instance, reported that high levels of test anxiety are negatively correlated with various cognitive components such as IQ, problem solving, memory, aptitude, and grades [20]. These cognitive components have been identified by Hembree, Sapp, Durand, and Farrell as the primary factor associated with performance decrements [20], [21], [22].

The authors of this paper claim that the emotional impact of grades may consequently affect learning aptitudes and retention rates during a semester span. Significant amount of research efforts focus on developing effective pedagogical approaches that enhance student comprehension and scholarship abilities in engineering education [8]. One of the most recurrent pedagogical techniques implemented in engineering education, and for professional training in medicine and related health professions, is known as Problem-based learning (PBL). This method centralizes towards the acquisition of knowledge and focuses on developing self-directed learning capabilities and critical thinking-skills through problem-solving, team skills, and interpersonal skills [8], [9]. The vast majority of engineering faculty, however, indirectly incorporate alternative pedagogical approaches such as Project-based learning methods or visual supplements during lecture sessions to enhance the physical understanding of fundamental concepts and expose students to real-world engineering applications [8], [9], [10], [11]. Marquez and Garcia, for instance, developed the ECNQ model (acronym for Engage, Communicate, Names, Questions) as an active and dynamic, pedagogical approach to engage students in the engineering classroom and disrupt traditional, ineffective teaching practices that limit student participation [23].

II. PROPOSED WORK

However, the emotional impact of grades may influence students to disengage from lecture sessions, or even from the entire course, regardless on the effectivity of the aforementioned pedagogical methods. As such, the authors found it imperative to conduct a pilot study that analyzed the short-term effects of grades on engineering students during the progression of the

semester; that is, at the start, during, and at the conclusion of the corresponding course. Though considerable amount of research efforts centralize on long-term psychological effects on students' desire to attain high grades, few studies have examined their short-term impact. This research study was intended to further understand the emotional state of the student when grades are factored into their coursework, and the potential actions they may consider to remedy undesired outcomes. Since grades are a critical component in procuring internship opportunities, joining undergraduate research laboratories, graduating, or being admitted into graduate school, it is critical to understand the potential short-term actions taken by engineering students when they receive expected, or unexpected grades.

Stage 1

The pilot study is structured to understand students' perspective on grades during three stages, 1) at the start of the semester, 2) mid-semester, and 3) at the conclusion of the semester. At the start of the semester, it may be expected that the notion of grades is relatively minimal given the absence of assignments. However, since academics is grade-driven and grades pose long-term psychological effects, it is of interest to observe the effect grades carry from one semester to the other. This effect may vary from student to student depending on previous course outcomes. If students achieved desired grades in preceding courses, for instance, it may be a strong indicative that grades may not be of distress at the start of the semester. However, if grades in previous courses were not as expected, students may carry emotional concerns that will hinder the retention of learning outcomes.

Stage 2

By mid-semester, nonetheless, students have submitted a number of assignments and earned a range of either favorable or unfavorable grades. As such, the authors find it critical to comprehend the emotional effect grades convey on students at this stage. Favorable results, for instance, may cause students to approach the course with a positive attitude and further engage in lecture sessions, homework assignments, or when seeking instructional assistance. Unfavorable results, nonetheless, may cause students to lose focus and disengage from lecture sessions, or even from the entire course, regardless on the effectivity of established instructional methods. As such, the authors are interested in understanding potential actions taken by students at this point, some of which may potentially include: pass/failing the course, dropping the class, stop caring, seek assistance, or change majors.

Stage 3

The authors are further interested in understanding the students' perspective on grades when the semester has concluded, particularly, whether it carry any psychological effect on learning outcomes, grade-point average, and co-curricular opportunities. It is postulated that student perspective will vary depending whether grades throughout the semester were as expected or not. Earning favorable grades, for instance, may reduce anxiety at the conclusion of the semester, while earning low grades may significantly alter anxiety levels regarding overall grade-point average and the potential exclusion from any sort of co-curricular opportunities.

As such, this research effort aims to expand the understanding of students' perceptions on grades and assist in the development of thoughtful, responsive, and effective solutions that meet student needs. These preliminary findings are imperative and require significant attention since they may affect student learning, retention of fundamental engineering principles, persistence in engineering programs, and overall student well-being.

III. METHODS AND ANALYSIS

For this study, a mixed-methods research design was utilized to understand the short-term effects of grades on engineering students during the progression of the semester, that is, at the start, during, and at the conclusion of the course. The context of the pilot study was a small private research university in Texas. The authors employed a convenient sampling technique in which a survey was distributed to a total of 45 sophomore students enrolled in a prerequisite, introductory level mechanical engineering course during the spring semester of 2019. The survey instrument consisted of a total of ten items, seven of which included Likert-Scale responses. All ten items employed open-ended questions which provided students an opportunity to share in detail their views and perspectives regarding grades.

The ten, self-developed survey questions were selected to attain student feedback on the three stages of study (Table 1). The student survey was informed by the Hamilton Anxiety Rating Scale (HAM-A) which is one of the earliest scales developed to measure anxiety symptoms. Traditionally applied in clinical research efforts, recent educational studies have utilized HAM-A to measure both engineering and medical students' perceived anxiety levels related to course, assessment, and graduation outcomes [24]. The scale consists of 14 items each defined by a series of symptoms, and measures both psychic anxiety (mental agitation and psychological distress) and somatic anxiety (physical complaints related to anxiety). For the purpose of this study, the authors focus on item 1 of the scale, anxious mood, to help assess the degree of students' perceived anxiety levels.

Question 1, for example, provided feedback regarding Stage 1, Questions 2-9 corresponded to Stage 2, and Question 10 complied with Stage 3. Descriptive statistics were employed for analysis and presentation of data results. The authors note the following limitations of the study: (a) small sample size; (b) self-developed survey instrument; (c) convenient sampling procedure; (d) single course evaluated. In this regard, the level of difficulty of the course and the instructors' attitude were not factored in the survey, which could have influenced the results.

The first question on the student survey was intended to understand the impact grades at the start of the semester. At such early stage, it may be concluded that the impact is relatively minimal given the absence of assignments. However, it is of interest to understand the psychological effect grades carry throughout matriculation, or from a preceding semester. The second question is incorporated to comprehend the emotional effects favorable grades convey on students mid-semester. It is assumed that satisfactory scores throughout the progression of the course may result in a positive attitude, and to further engage in lecture sessions, homework assignments, or when seeking instructional assistance. However, results may indicate otherwise. The adjoining question is incorporated to comprehend student behavior when unfavorable grades are acquired. In this case, the authors are inclined to conclude that unfavorable grades may provoke a negative stance

towards the course, and consequently influence student disengagement from lecture sessions, or even from the entire course, regardless on the effectivity of established instructional schemes.

Table 1. Survey Questions

Stage 1 – Start of Semester
<i>Question 1.</i> How anxious do you get about grades when the semester begins?
Stage 2 – Progression of Semester
<i>Question 2.</i> If your grades are as you expected mid-semester, how concerned are you with grades moving forward?
<i>Question 3.</i> If your grades are not as expected mid-semester, how concerned are you with grades moving forward?
<i>Question 4.</i> Do you constantly check your grades through the online portal?
<i>Question 5.</i> How frequent do you check your grades?
<i>Question 6.</i> How do you feel when you have high grades in class?
<i>Question 7.</i> How do you feel when you have low grades in class?
<i>Question 8.</i> How easy is for you to concentrate in class when you have high grades?
<i>Question 9.</i> When grades are not as you expected in any of your classes, what will you most likely do?
Stage 3 – Conclusion of Semester
<i>Question 10.</i> How anxious are you about grades at the end of the semester?

In an effort to understand the influence grades impart on student behavior, the fourth question is integrated to determine the frequency in which grades are monitored through online portals. Monitoring grades on a recurrent pattern, for example, may be an indicative of the students’ academic performance throughout the semester. It can further indicate students’ confidence level in the course, whether anxiety is effectuating, or it may simply be a monitoring habit.

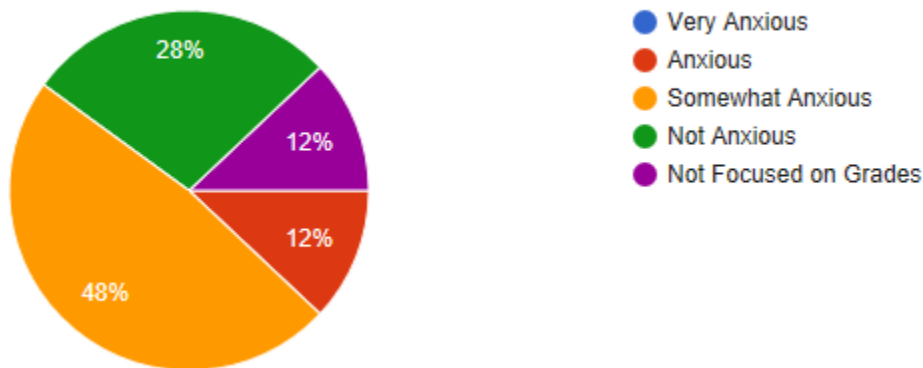
The fifth question precedes Question 4, and it renders exact measures regarding the frequency in which grades are monitored. The subsequent inquiry on the survey evaluates students’ perception regarding academic competence, personal satisfaction and motivation, and career outcomes when grades are as expected throughout the semester. It is expected that students’ perception on such outcomes remain overall positive, and that anxiety or worry about procuring career opportunities post-graduation diminish with high grades. The seventh question, however, is implemented to understand the effects of self-efficacy, confidence, and motivation when low grades effectuate. The authors speculate that low grades induce psychological effects that lead to anxiety, apprehension, and eventually poor-decision making. The next survey inquiry targets the students’ attitude and behavior towards the course and lecture sessions when high grades are recurrent throughout the semester. Such results may indicate whether students retain academic focus for the remainder of the semester, or if it dissipates.

The following question intends to contemplate student reaction on the opposite spectrum. The authors are particularly interested in understanding potential actions that may be taken at this point, some of which may include: pass/failing the course, dropping the class, stop caring, seek assistance, or change majors. These measures may be taken for numerous reasons including course difficulty, time management, or finding an alternative solution to retain a relatively high grade-point average. Lastly, it is intended to grasp students' perspective on grades at the end of the semester, regardless if they are favorable or not. Grades may influence student expectations after culminating the course, but it may also carry psychological effects on co-curricular opportunities or future courses.

IV. RESULTS

Stage 1 - Results

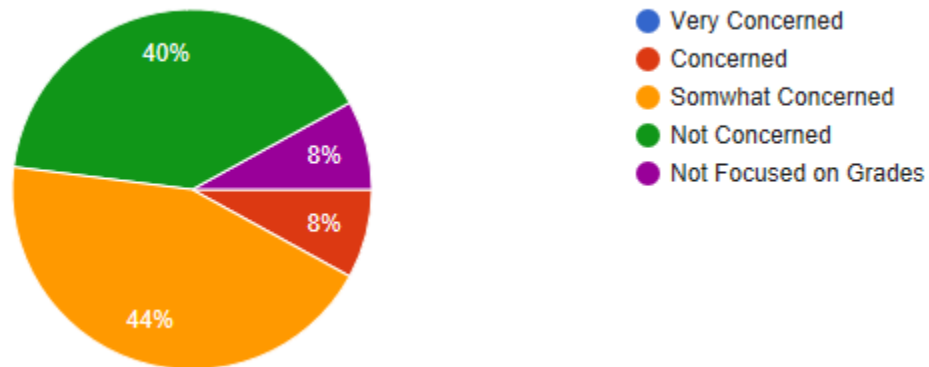
Question 1. How anxious do you get about grades when the semester begins?



For question one, a total of five response options were outlined: 1) very anxious, 2) anxious, 3) somewhat anxious 4), not anxious, and 5) not focused on grades. This question, and those that follow, were informed by the HAM-A in which items were based on a scale 0 (not present) to 4 (severe). Preliminary results indicated that 60% of the population encountered a sense of anxiety regarding grades at the start of the semester, 12% of which experienced anxiety about grades, while 48% felt somewhat anxious. Such elevated percentage demonstrates the importance of grades early in the semester, which may be interpreted as affirmative or alarming, depending on the stance associated with career outcomes, self-efficacy, motivation, or past academic experiences. Additionally, 28% did not express any sort of anxiety and 12% were not focused on grades at all.

Stage 2 - Results

Question 2. *If your grades are as you expected mid-semester, how concerned are you with grades moving forward?*



For question two, a total of five response options were outlined: 1) very concerned, 2) concerned, 3) somewhat concerned, 4) not concerned, and 5) not focused on grades. Preliminary results indicate that 52% of the surveyed population conveyed a level of concern with grades despite having expected scores, 8% of which felt concerned, while 44% felt somewhat concerned. This significant finding verifies that student concern about grades is not only associated with low grades, but with high grades as well. Furthermore, 48% of the students surveyed did not express any type of concern with the course if grades were as expected mid-semester, 8% of those mention not focusing on grades.

Open-ended responses reveal students displaying minimal concern if mid-term grades align with expectations. A common trend indicates that students possess a significant level of confidence and motivation in maintaining their grades throughout the semester.

“I’m fairly sure that if my grades are satisfactory mid-semester, I can uphold that to the end of the semester.”

“High grades tend to motivate me not to fall behind. It gives me confidence that I can get a good grade overall.”

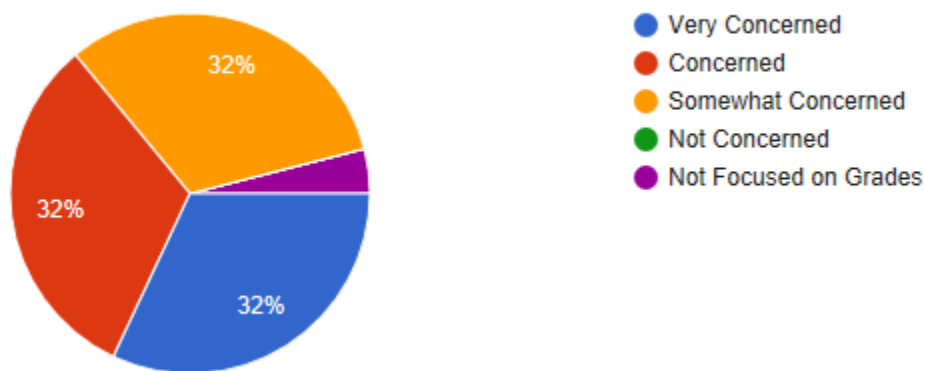
I won’t be concerned if things are going as expected, so I can stay on the same path.

Nonetheless, several students expressed concern regarding the effort to maintain the level of motivation necessary to obtain high grades. One particular student acknowledged the harsh reality that numerous career aspirants face after completing their undergraduate engineering program.

“My GPA is not as high as I want it to be. There is a concept that if you don’t have at least a 3.5 most the doors will be closed in the future. Honestly no matter what happens I will be somewhat concerned.”

“Even if I have the grades I expected at mid-semester, I still worry about my motivation slipping and my grades dropping as the semester progresses.”

Question 3. *If your grades are not as expected mid-semester, how concerned are you with grades moving forward?*



For question three, a total of five response options were outlined: 1) very concerned, 2) concerned, 3) somewhat concerned, 4) not concerned, and 5) not focused on grades. Preliminary results revealed that the level of student concern significantly increases at mid-semester when students fail to meet the expected grade outcomes. Notably, 96% percent of the participants demonstrated a level of concern when grades are not as expected, 32% of those felt very concerned, 32% felt concerned, and 32% felt somewhat concerned. Only 4% indicated not focused on grades. These significant findings may cause students to disengage from lecture sessions, or even from the entire course, regardless of the effectiveness of the established pedagogical methods. As such, students may opt to pass/fail the course, drop the class, stop caring, seek additional assistance, or simply change majors.

Open-ended responses reveal that these unexpected outcomes impose significant effects on various psychosocial impacts such as increased anxiety levels, motivation, and perceived self-efficacy. Increased pressure and stress to improve classroom performance stimulate forces students to adopt certain behaviors that will remedy the predicament.

“If my grades aren’t as expected then the stress is definitely higher, however, I still generally take things one day at a time and I’ll create a plan to get my grades back on track. Sleep definitely suffers though.”

“Motivates me to try harder but also damages my confidence which tends to decrease my performance.”

“Trying to improve grades puts extra pressure to keep working hard.”

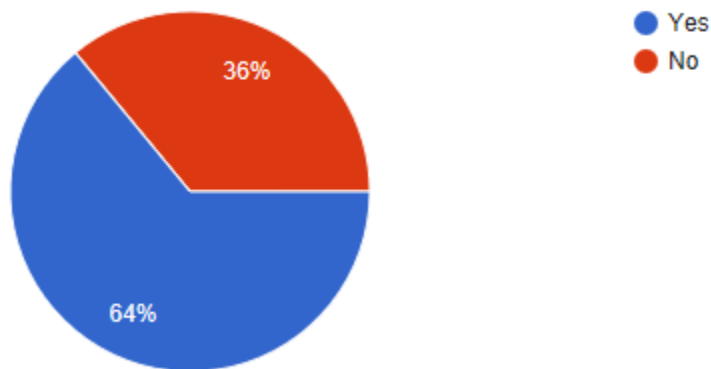
“I need to maintain a decent GPA for internships, but I think I have enough of a buffer where this shouldn’t be a huge problem.”

“If my grades are bad (C or D), then I get very worried and anxious about the class.”

“I would be much more anxious to make up for them and study more.”

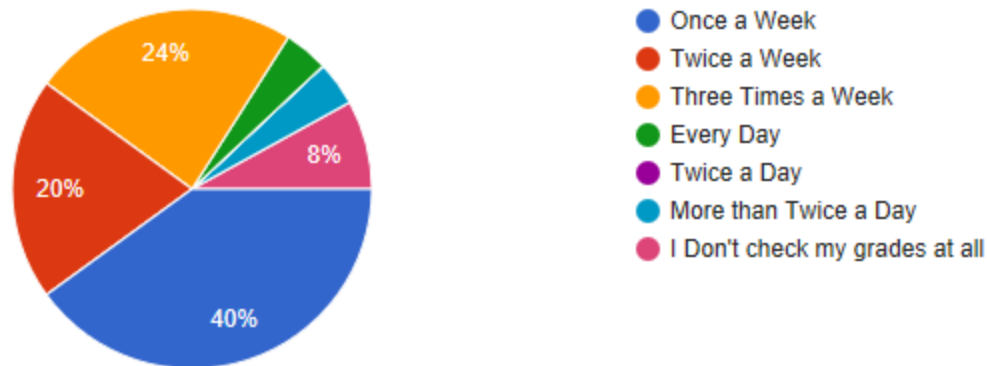
Based on student responses, it is evident that students’ self-efficacy beliefs diminish significantly when mid-semester grades are not as expected. However, several students expressed that low grades serve as motivator to improve classroom performance. Unexpected grades also serve as a trigger for negative, even harmful student responses. The effect of not attaining high grades can further contribute to the persistent issue of student retention and completion in science and engineering disciplines.

Question 4. *Do you constantly check your grades through the online portal?*



According to preliminary results, nearly two-thirds (64%) of the students acknowledged constantly monitoring grades through online portals, while 36% of the population abstained from such medium. These results are meaningful given that constantly monitoring grades may be an indicative of the students’ academic performance throughout the semester, which could be satisfactory or unsatisfactory according to personal expectations.

Question 5. *How frequent do you check your grades?*



For question five, a total of seven response options were included: 1) once a week, 2) twice a week, 3) three times a week, 4) every day, 5) twice a day, 6) more than twice a day, and 7) I don't check my grades at all. Results indicated that 92% of the surveyed students monitor their grades at least once a week, 40% indicated once a week, 20% monitor twice a week, 24% three times of week, 4% monitor once a day, and 4% more than twice a day. The number of occurrences may be associated with academic performance in the course, anxiety regarding final grade and how grade-point average may be affected, or simply as a motivator to continue performing according to expectation.

Question 6. *How do you feel when you have high grades in class?*

The types of feelings reported by the students when they are experiencing academic success, as measured by class grades, are positive in nature and serve to promote self-affirming attitudes and beliefs about academic competence. It additionally benefits increased levels of personal satisfaction and help validate the positive outcomes that are generally attributed to investing time and effort into learning and studying the course material.

"I feel great, like I'm on top of the world."

"Unconcerned, maybe even lazy."

"I feel confident and proud of myself, especially if I worked hard for them."

"It helps as a motivator that you understand the material."

Aside from the general feelings of personal satisfaction, several students conceptualized the linkage between high scores (academic achievement) with positive career and life outcomes. As indicated by the comments below, students noted that obtaining high grades are a mechanism for attaining high quality, post-graduation academic and career opportunities.

“I won’t deny that having high grades feels good. It has been positively reinforced since I was a child, and it gives you a sense of security for getting a job, internship, etc.”

“Exuberant. It means that I am making good steps towards securing my future.”

Question 7. *How do you feel when you have low grades in class?*

Low performance as measured by grades can have highly damaging and negative consequences on students perceived self-efficacy, confidence, and motivation. As indicated by the participants’ statements, students begin to question their capability to comprehend class material which impacts their sense of self confidence to achieve academic success.

“I feel terrible.”

“Nervous and slightly concerned/stressed for my grade.”

“Anxious because it will affect my GPA and I’m not sure that I’m learning well.”

“Stressed out, hyper.”

“I feel terrible and dumb. Like I know nothing in the class which is usually not true.”

“I feel a little depressed since grades are one of the focal points in college.”

“Like an impostor, someone who doesn’t deserve to be at Z university and isn’t smart enough to succeed in this major.”

“Consistently getting a bad grade shakes my confidence and makes me uncertain whether I’m capable of understanding the material.”

These statements of student performance measures should be a focal point of concern for STEM educators given that nearly half (48%) of students who initially pursue STEM majors end up studying a different major, or withdraw from college without completing a degree due to performance related factors [12]. As such, non-cognitive factors have been shown to impact engineering students’ retention and completion outcomes.

Question 8. *How easy is for you to concentrate in class when you have high grades?*

The eighth question on the research survey targets the students’ approach toward lecture sessions when high grades are recurrent throughout the semester. Open-ended responses reveal a tendency amongst students to relax when grades are as expected in the course.

“It actually sometimes gets tough because I start to relax my focus since I feel that I can coast on my good grades.”

“So-so, if I feel like I’m doing well in a course I have a tendency to doze.”

Other students acknowledged that earning high grades is rewarding as it eliminates stress and allows them to focus and enjoy class.

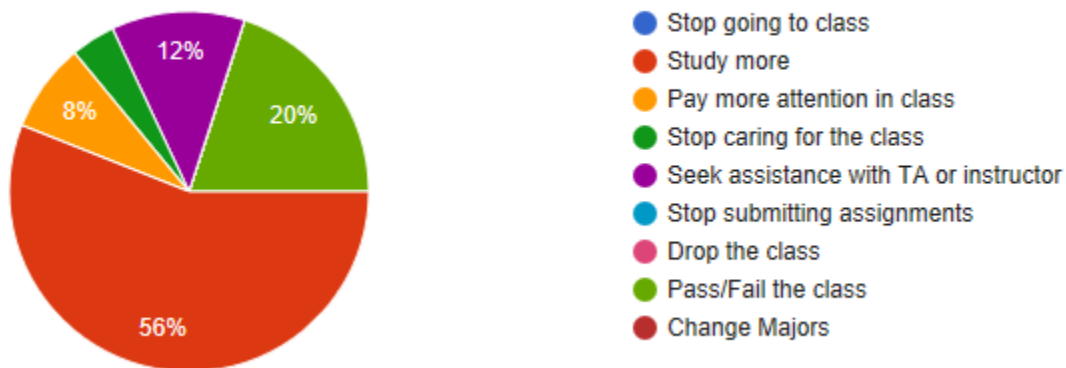
“It’s relatively easy, since usually when I have high grades it means I understand the previous material well and I’m ready to move on to new material.”

“I am more relaxed so it helps me focus on the lecture itself rather than taking notes.”

“Easy – there’s no real stress in the class and I just go and enjoy the material.”

“Easy because I’m not stressed.”

Question 9. *When grades are not as you expected in any of your classes, what will you most likely do?*



For question nine, a total of nine response options were included: 1) stop going to class, 2) study more, 3) pay more attention, 4) stop caring for the class, 5) seek assistance with teaching assistant (TA) or instructor, 6) stop submitting assignments, 7) drop the class, 8) pass/fail the class, and 9) change majors. Preliminary results indicated that when grades are not as expected, 56% of the surveyed students will study more, 20% will pass/fail the course, 12% will seek assistance with the teaching assistant or instructor, 8% will pay more attention, and 4% will stop caring for the class. These findings are paramount in engineering education as they reveal the emotional effects and the actions taken by students when grades are not favorable. Low grades can further be associated with student disengaging from lecture sessions or from the entire course.

The open-ended responses reflect that most students will increase their effort to study more when grades are not as expected, others will simply pass/fail the course. Students additionally acknowledged that timing (e.g., drop deadlines) impacted their choice to study more or to withdraw from a course, which was identified as a practical solution to avoid any harm to overall grade-point average.

“I’ve actually done literally all of these in the past. However, these days if it’s early in the semester I might drop it, but if it’s past the drop deadline, I’ll just end up studying more and going to TA sessions and office hours.”

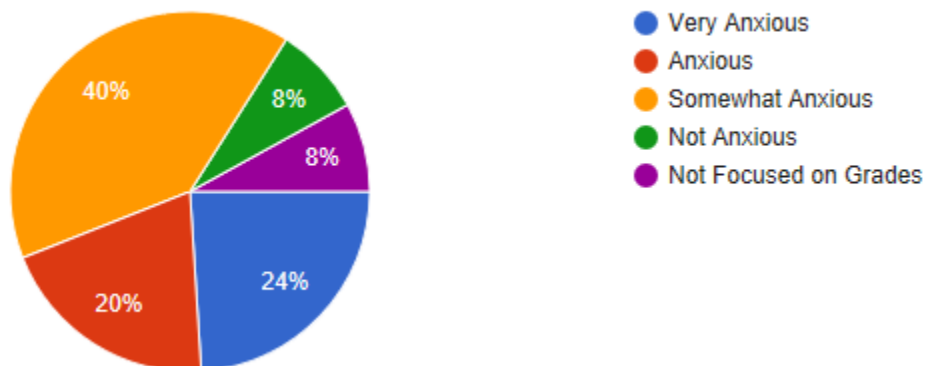
“I’d still work hard on the class but I’d pass/fail it so it doesn’t threaten my performance on other courses and extracurricular.”

“It mostly depends on what point in the semester we are. Like if it is the first mid-term, I will try to study more so I can raise my grade. Bui if it is almost the end of the semester, I may drop the class, pass/fail it, or change majors.”

“I would say a combination of ‘study more’ and ‘stop caring for the class.’ I just continue to feel down on myself if my grades aren’t up to par.”

Stage 3 - Results

Question 10. *How anxious are you about grades at the end of the semester?*



For question ten, a total of five response options were outlined: 1) Very anxious, 2) Anxious, 3) Somewhat anxious, 4) Not anxious, and 5) Not focused on grades. Preliminary results indicate that 92% of the survey students experience anxiety at the end of the semester. Nearly half of the students (44%) reported expressing high levels of anxiety, while an additional 40% noted they were somewhat anxious regarding their grades. Results reveal that only 8% of the students reported not being anxious about grades.

Regarding grades at the end of the semester, open-ended responses reveal that students' experience increasing levels of anxiety and tend to focus on major exams that compromise a significant portion of their overall [course] grade.

"Need to maintain good grades for internship and grad school."

"If I am doing well, I am not anxious, if I am doing poorly, I am."

"At this point what's done is done, and it's hard to drastically alter your grade in the course even with a perfect grade on the final, so I'm usually a bit more relaxed by the end. Still always some stress about grades though."

"This is around the time when I worry most about the big assignments/tests of the class that will take a large amount of my grade for the class. Because it is so close to the end, I can start estimating my GPA for next year based on different possible outcomes. This worrying gives me anxiety."

"I know that GPA is huge in college, and I tend to focus on grades most when they're about to finish."

V. CONCLUSION

It is widely accepted that grade-point average is a strong indicator of overall student intellect and predictor of positive post-graduation outcomes and success. A high GPA opens doors to a host of career advancement and development opportunities. Since the day of enrolling in formal education, students are socialized into accepting the notion that grades are an indicator of their aptitude and overall intelligence. This accepted belief is carried with them through the entirety of their K-12 experience and eventually matriculates into the higher education environment where the stakes are even higher. As such, the need to obtain a high GPA is a top priority for students, since GPA is linked to attaining quality career and professional opportunities and outcomes. Thus, students tend to focus much of their time and energy on securing high grades that will help boost their post graduate career outlook. While many students realize their goals of earning high grades, others fall short of their scholarly intentions, which can threaten their college and career aspirations and ambitions. Though a considerable amount of research has examined the psychological effects of students' desire to attain high grades in engineering disciplines, few studies have examined the short-term effects of grades on engineering students during the progression of the semester.

This preliminary study sought to better understand engineering students' perceptions, views, and attitudes towards grades at three different time points. It is emphasized that the study was limited to only one course, which clearly impacts the results given that stress levels may vary depending on the difficulty of the class, student classification, or instructor's attitude. The data obtained, however, revealed insights on the impact of grades on students' self-efficacy, motivation, and decision making throughout the progression of the semester. Based on the findings, the authors

contend that by adopting an intentional and systematic process of surveying and chronicling students' experiences during the semester can help to develop intervention strategies that proactively address issues plaguing engineering disciplines such as student retention, completion, and overall well-being.

Implications for Future Work

Despite the notion that learning is the most important aspect in higher education, grade anxiety may lead students to adapt various alternatives such as memorization or at times honor code violation in order to attain the desired grades without much effort. As such, the authors believe that the emotional impact of grades affects student learning and retention rates. Despite the effectivity of numerous pedagogical approaches established to enhance student comprehension and scholarship abilities such as Problem-based learning or Project-based learning, it is postulated that engineering students may additionally disengage from lecture sessions, from the entire course, due to the emotional impact of grades.

Given the relevance of the results, the authors have identified three opportunities to extend and broaden the impact of the study. The first opportunity consists of conceptualizing an alternative grading scheme that reduces grade anxiety and helps student learning and retention in engineering education. It includes proposing alternatives such as a grade-scale change or one-to-one evaluation sessions that will decentralize students from a grade-driven mentality and improve student well-being and a healthier learning environment. For such schemes to effectuate, however, it is imperative to first conduct a study which evaluates the position of engineering undergraduate students regarding learning, memorization, and grades.

The second opportunity for extending this research is to initiate a longitudinal study with the research participants to help gauge and track their experiences within other classroom settings. This will provide insight and additional data to help identify patterns and emerging themes which will help inform future practice.

Lastly, the authors plan a phase 2 of this research that consists of distributing an electronic survey to students enrolled in the College of Engineering and conducting qualitative interviews with a select group of students to help broaden the research sample size and increase the replicability, reliability, and generalizability of the study. This approach will further validate the findings by delving deeper into students' perceptions and help understand students' perspective on grades.

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