

# **Working Full Time and Earning an Engineering Degree: Wellbeing in a Co-Op-Based Engineering Program**

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## **Abstract**

The purpose of this research paper is to describe how stress manifests in undergraduate engineering students who are working in paid engineering positions while completing their upper-division coursework, through the analysis of reflective prompts on wellbeing, and engineering belongingness. Previous research has identified the culture of “suffering and shared hardship” where heavy workloads and stressful situations are expected in engineering programs and engineering as a discipline. Stress, specifically feelings of being overwhelmed with workload, has far reaching implications for an individuals’ wellbeing beyond academic performance.

We focus on the frameworks of self-determination theory, engineering belonging, and identity to better understand undergraduate engineering students’ wellbeing. Our population for this study is approximately 70 students at a large, public, primarily undergraduate institution in an off-campus co-op based learning program. In this upper-division program, students complete their BS in Engineering in five semesters after completing their lower division coursework at community colleges across the nation. For four semesters, students complete technical, professional, and design coursework while working as paid engineering interns. As part of their coursework, students regularly complete reflections on technical, professional, and design topics.

The reflections of 24 undergraduate engineering students on health, wellbeing, and belongingness were analyzed using an open coding, thematic approach. Each student has completed 3 reflections on health, wellbeing, and belongingness. The results identify stressors and coping strategies utilized by engineering co-op students. Strategies such as establishing a stable routine is identified as a critical coping mechanism. Further connections of wellbeing and belonging are described. Students identified relatedness as key to feelings of belonging in engineering and imposter syndrome as a key barrier to belongingness.

## **Introduction**

In this work we seek to describe undergraduate engineering student wellbeing in a co-op based program through the analysis of reflective prompts on general health, wellbeing, and engineering belongingness. We take an exploratory qualitative approach, backed by theoretical foundations of self-determination theory [1], engineering identity [2] and belongingness [3].

Student success has often been measured by academic outcomes; in this work we frame student success more broadly using the framework of Engineering Thriving [4], which takes a more

holistic approach to student success considering many different perspectives within engineering education literature: intrapersonal, interpersonal, cognitive, and behavioral competencies. Framing student success as thriving is critical for engineering, with growing concerns for engineering students' wellbeing. For example, stress and high levels of anxiety have been identified as prevalent in engineering students [5]. The culture of engineering has included a level of pride associated with the difficulty of the field [6], and stress culture of engineering has been identified [7]. Bringing a focus of wellbeing and thriving to engineering education can be critical for making meaningful change.

The goal of student success or thriving is ultimately to provide a positive educational experience that supports student growth and development as engineers. In this co-op based program, students gain experiences that will help prepare them for careers in engineering after graduation. Cooperative (co-op) experiences have been shown to prepare work-ready graduates, with evidence that students with co-op experiences are more likely to get full time employment after graduation and with higher starting salaries [8]. However, co-op experiences have been shown to have the potential of adding to the psychological distress of students [9], reducing overall wellbeing. With co-op experience being a valuable tool for gaining and applying engineering knowledge, identifying ways to support students thriving while on co-op is important.

**Programmatic Context.** We explore student thriving at the Iron Range Engineering (IRE) Bell Program, which is an upper-division, co-op based, engineering program. Bell is based on the award-winning IRE, project-based learning program [10], where rather than gaining project experience through industry projects completed in student teams on-campus, students gain design experience in engineering co-ops. In the Bell Program, students complete lower-division coursework (first- and second-year coursework), typically at community colleges across the nation. Students then complete their B.S. in Engineering in 2.5 years in the Bell Program. The first semester focuses on preparing students for co-ops through the development of their design, professionalism, and technical skills. Students continue completing coursework while working full time (average of 40 hours per week) in engineering co-ops.

The Bell program focuses on developing students as work-ready graduates, with evidence-based practices, including helping students develop as self-directed learners [11]. For example, students in their first semester of Bell, attend workshops on self-directed learning as part of their required professionalism coursework. Topics in the workshop include self-regulated learning strategies such as time management techniques [12], [13]. Students also attend professionalism workshops on topics around wellbeing, such as life-work balance, further supporting the development of coping strategies, or actions to take to manage wellbeing [14]. In Bell, faculty and staff discuss self-directed learning strategies with students that they then can utilize as coping strategies.

Participants engage in self-directed learning workshops, assignments, and activities throughout their time in the Bell Program.

Technical courses are structured in 1-credit hour competencies, and at the time of this study, these competencies occurred monthly— 1 credit per month. These technical competencies are designed to cover core material and completed in shorter time periods, so that students can choose the technical topic to cover that month to apply to their engineering work in a timely and personalized manner [11]. Bell students also receive weekly one-on-one mentoring sessions with Bell staff named “learning coaches.” Learning coaches are used as a resource for student tracking across all aspects of their pathway, including coursework, job search, design experience, and life transitions, such as switching co-ops or moving.

Data were collected during the COVID-19 pandemic. Students were taking classes remotely from their co-op or project locations, as a planned part of the program. Although the pandemic did not have a significant effect on the instructional methods for these students, the ongoing pandemic contributed to students’ wellbeing and coping strategies and is discussed in this paper.

**Positionality Statement.** In addition to the programmatic context for this study, we provide further context through a positionality statement for the authors of this paper. The first four authors on this paper are instructors at IRE Bell. The first author is an assistant professor, who instructs technical competencies and professionalism workshops. The second and fourth authors are learning coaches who frequently discuss strategies and resources with students on a personalized level.

The third author is an adjunct professor who leads the self-directed learning workshop series. Author one has experience in engineering education research, in neurodiversity and motivation. Author three has experience in engineering education with self-directed learning and motivation literature. The fifth author is a professor at another institution with experience in engineering education research methods and neurodiversity and motivation topics.

## **Background**

The open, qualitative approach of this work relies heavily on existing literature on wellbeing in engineering, engineering identity and belongingness, and self-directed learning, which we further describe in this section.

**Wellbeing and Self-Determination Theory.** We define wellbeing in this paper as “optimal psychological functioning and experiences” [15, p. 142]. Ryan and Deci [15] discuss wellbeing in terms of either hedonic—focused on pleasure and happiness based on self-interests—or eudaimonic—focused on fulfillment of an individual’s values, separate from subjective

happiness. Self-determination theory, a psychological theory commonly applied in engineering education, pulls from eudaimonic wellbeing with the fulfillment of three core psychological needs— autonomy, competence, and relatedness [1]. Autonomy is the need or desire of an individual to have control over their decisions and goals; competence is the need or desire to be effective at the work they are doing; and relatedness is the need or desire to feel loved and connected to others [1].

Wellbeing has been measured through the application of objective wellbeing measures, such as number of surgeries or hospital visits [16]. How an individual views their own wellbeing is described through subjective wellbeing [17]. In measuring wellbeing through self-reports, such as reflections, we will be looking inherently at subjective wellbeing, or the students' evaluation of their life as a whole [17].

Wellbeing has been connected to co-op experiences and job satisfaction; for example, Cormier and Drewery [9] identified that co-op placement can have an effect on subjective wellbeing [9]. Students who do not place in a co-op, particularly when those individuals focus on their peers who have successfully obtained a co-op, describe a decrease in overall wellbeing. Additionally, feeling satisfaction in autonomy, competence and relatedness at work have been found to be positively correlated with job satisfaction [18].

Methods for managing wellbeing, including specific actions taken to improve wellbeing, are discussed in this paper as coping strategies. Coping strategies have been discussed and studied alongside stress and anxiety [14], which we consider in this work a key contributor to student engineers' wellness, based on existing literature on stress culture in engineering [7]. In engineering, wellbeing has been defined broadly, to include societal contexts and belongingness [19], as such, we have included analysis of a reflection on belongingness and explore connections to wellbeing.

**Feelings of Belonging in Engineering.** Belongingness, much like competence, autonomy, and relatedness in self-determination theory, is a key psychological need [3]. In this paper, we discuss belongingness through the framework of engineering belongingness, or the perceived connectedness and social support in the field of engineering (Straythor, 2018) or more specifically, in their engineering co-op. Studies have identified that engineering students with high feelings of belonging in engineering describe interest in their coursework and indicate competence in engineering-related coursework [20]. As such, belongingness in engineering is closely related to engineering identity.

Engineering identity is a well-established framework in undergraduate engineering education; engineering identity is discussed in terms of three main constructs: interest, recognition, and

performance/competence [2]. Whether or not an individual wants to establish an identity as an engineer is largely based on interest, or the affinity towards the subject matter in engineering [21]. How others view the individual can shape the formation of the individuals' own identity; recognition is how much an individual feels recognized by others as being an engineer. Performance/competency extends beyond task-specific self-efficacy and includes an individuals' beliefs about their abilities and knowledge in the field of engineering [2].

Identity development, particularly in performance/competency, has been shown to be supported by project-based learning [22], the model this co-op based learning program is based on. Studies on engineering identity have shown that co-op experiences can help support students identity development through meaningful contributions to projects [23]. Co-op experiences have also been shown to improve feelings of belonging in engineering [20].

**Self-Directed Learning.** Knowles [24] first defined self-directed learning (SDL) as "a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" [24, pg. 18]. Even with its beginnings in adult education, SDL has merged into the undergraduate education realm with SDL being viewed as a personal attribute that can be taught, learned, and put into practice [25]. Practically, self-directed learning encompasses aspects of motivation, self-regulation, personal responsibility, and autonomy [26]. Motivations may include examples such as grit [27], [28] or self-efficacy [29], [30], [31] that influence the learner's engagement in a learning activity. Self-regulation, studied heavily in the self-regulated learning psychology literature, refers to the ability to plan, control, and adapt one's feelings and actions during the process of meeting personal learning goals [12,13]. Personal responsibility refers to owning personal actions, the internal side of self-directed learning, and autonomy, a more external reaction during the learning process, to taking control of learning choices [32].

Engineers are called to be lifelong learners; even as recently as 2020, continued learning, and thus the skills to do so on the job, are seen as vital pieces of becoming and being an engineer [33],[34]. Thus, self-directed learning is being taught [35], [36], [37], [38] and studied [39], [40],[41] in engineering and engineering education. A previous study of Industrial Engineering students showed that they could learn and reflect on goal setting, planning, self-monitoring, self-evaluating and other self-regulatory strategies successfully within the context of a course [42]. More recently, a study of civil engineering undergraduates showed that including self-regulated learning and goal setting were vital for cognitive engagement in courses [43]. Self-directed learning has also shown useful for engineering majors during the COVID-19 pandemic, as a mediator of other external and environmental effects [44].

## **Method**

In this study we utilize an exploratory qualitative approach with thematic analysis and a posteriori coding scheme, informed by literature in wellbeing, belongingness, and self-directed learning. Although some frameworks exist, such as in engineering identity, we believe an exploratory approach is appropriate for the data and the context in which it was collected. The reflections were not designed for or intended for research purposes, and as we were not able to ask follow up questions, the scope of the discussions in the reflections could breach a variety of topics.

**Data Collection.** Data for this study are reflective prompts that are a typical component of the curriculum in our program completed by n=24 students. Three reflective assignments were used for this study; the assignments were given approximately one month apart in the order listed here, by topic: Health, Wellbeing, and Belongingness. Each assignment consisted of four reflective prompts, for a total of 12 prompts for analysis. Examples of these prompts include: “Reflect on your current state of mental health and general wellbeing. Describe anything you are willing to share here” and “Describe a few ways in which you feel like you belong in either the engineering profession or your current position/project.” The full prompts are included in Appendix A.

The length of the responses ranged from one sentence to three paragraphs, with most responses about a paragraph in length. The assignments were collected on an online classroom platform; no names or readily identifiable information is on the documents submitted. Author 1 downloaded each individual’s three assignments, which were saved together, and kept together through the analysis. These were saved using gender-neutral pseudonyms (selected through a website for most common unisex baby names for 2021). The researchers did not know the identity of the individuals throughout analysis.

**Participant Description.** Participants of this study are students who completed all three assignments in the same semester. Of the 70 students in the program, 24 fully completed these three assignments in that time period. These 24 students were all at the same point in their academic pathway. To avoid identifying individuals, we will not attach any specific demographic information to this data to individuals, including year in school. Any demographic information, not shared in the reflections, were not known by the researchers during analysis.

In the Bell Program, about one third (30%) of Bell student engineers identify as having a disability; almost half (42%) are first generation college students; and one third (33%) are nontraditional students. Women are underrepresented, with 17% of students identifying as female compared to 22.5% nationally in engineering [45]. Racial demographics in the Bell program are

comparable to national engineering demographics; 60% identify as white (compared to 60.7% nationally), 12.3% identify as Hispanic (12.1% nationally), and 12% identify as multiracial [45].

**Data Analysis.** Once the three assignments had been collected, the three researchers began analysis by separately reading through students' reflective prompts for an initial thematic analysis. The reflections were read through, with initial thoughts and interpretations. Summaries of the students' experiences were created by each researcher through notes and memos on the margins of the students' assignments. The researchers then met to discuss the summaries and begin to identify common themes and applicable frameworks for the next steps of analysis. Although the researchers approached the data with some reasonable idea of what content may be covered, the thematic analysis allowed the researchers to further identify potential frameworks that would be beneficial in analyzing the data.

The researchers then collectively worked through one individual's reflections, chosen for their average response lengths, to create an initial codebook. Units of code were identified as sentences or phrases, and codes were descriptive words to describe that unit of meaning. After this reflection, each researcher worked through the full set of reflections, collectively building a codebook. The code creation continued as an iterative process, where researchers continued to discuss the emergence of new codes and distinguishing between the meaning of each code. After this more free-flowing iterative process, the researchers met again to refine and finalize the codebook, identifying redundant codes and clarifying definitions. A final pass through each of the reflections was completed using the final codebook. The finalized codebook is provided in Appendix B, including examples of outputs of the open coding.

Finally, from these codes each researcher independently identified themes in the data. Researchers met again to share and refine their identified themes. These themes are described below in the results and discussion, presented with participant quotes and examples, and connected to literature.

## **Results and Discussion**

**Coping Strategies.** Analysis resulted in a finalized codebook for use of analyzing the reflective prompts for wellbeing, belongingness, stressors, and coping strategies. Students were prompted for coping strategies, and thus wrote explicitly about those strategies. We identified eight key categories for coping strategies, that are named based on wording from engineering thriving and SDL frameworks, as well as student wording. These are shown in the codebook in Appendix B.

Students expressed a wide variety of coping strategies. Several coping strategies emerged that were not specifically discussed in workshops, such as traveling, spending time with pets, and



media use (i.e., “binge watching” television). However, many of the coping strategies were discussed in their workshops on self-directed learning. Self-regulation strategies such as managing emotions during a task, and visualizing long term goals were taught and used effectively by students:

“I think that the best coping strategy when dealing with work-related anxiety is to write down any tasks that you are responsible for completing. This helps to visualize what has to be completed which makes it easier to make a plan for these tasks.” -Alex

However, we did note instances where self-regulation strategies were used in ways that were harmful:

“I have tried to...do the brute force method of just pushing through it... This method worked for approximately 3 months but now I am getting burnt out. I usually worked with this method in junior college, and it worked well for the three years I was there. However, the classes in Minnesota are too fast-paced for this type of brute force.” -Jude

In addition to a wide variety of coping strategies, we noted instances where students indicated strategies that were not helpful for them. Strategies that work for some students, do not work for all students. Alex, Aiden, and Kyle’s descriptions of how using meditation as a coping strategy has or has not worked for them:

“I got into meditation for a period of time, which I found helpful.” –Alex

“Meditation has not always worked for me, sitting in silence causes me to think too much and can bring unwanted anxiety.” –Aiden

“There are 2 habits I would like to begin and maintain: meditation and exercise. I have always tried to meditate but I found it very difficult. To help me through the initial difficulty of starting a new and difficult habit, I have signed up for [meditation classes].”  
–Kyle

**Connection of Belonging and Wellbeing.** Students were not specifically prompted to reflect on the connection between belonging and wellbeing. However, in some responses to wellbeing prompts belongingness was discussed and vice versa. These responses are discussed here. For example, Maeve discusses the effect that not being recognized by their superior has on their mental health, in response to the prompt to reflect on current state of wellbeing:

“Mentally I am feeling constantly exhausted as if I can’t get enough rest for my brain, but I push through telling myself to just make it through the day every morning. There are aspects of my job that I hate, especially feeling as if the main boss in the department doesn’t like me. I know it doesn’t really matter much because my other bosses and the ones who will be reviewing me like me enough that they’ve let me use them as references in my search for my next Co-Op, but the feeling that I have disappointed a superior is not something that I handle well.” –Maeve

The literature supports this connection between wellbeing and belongingness; in education, environments that support student wellbeing also support the development of identity and the feelings of belonging associated with those [46]. Interest is a mediating factor, particularly for underrepresented groups, such as women of color and first-generation college students; interest has been shown to be a stronger determinant of persistence in engineering than either identity or belonging alone [21], [47]. In reflecting on ways to improve feelings of belonging, Kyle identifies the connection between hobbies, interests, and feelings of belonging in engineering:

“I think embracing continuous improvement can help improve my feeling of belongingness to engineering during my engineering work. I also think that indulging those hobbies outside of my engineering work can help by giving me balance. Hobbies are something I have neglected, and I need to start doing those things again. Possibly hobbies with a technical aspect can also re-invigorate my belongingness to engineering.”  
–Kyle

Finley also discusses a lack of interest in a specific focus has led to a lack of feelings of belonging:

“I think my lack of determination about [specific engineering discipline] causes the lack of belongingness. I often think if I can achieve more if I am in a different major.” -Finley

Similarly, Aria describes a coping strategy of managing their workload based on interests and passions to maintain wellbeing. In response to what coping strategies have been helpful:

“One of the ways I’ve dodged burnout in the past, while witnessing co-workers succumbing to it is by simply easing off. I usually do what I want when I want, meaning if an activity at work isn’t currently bringing me joy, I’ll happily switch to another task that is.” –Aria

Wellbeing is also discussed in connection to motivation, defined generally by student reflections. In response to reflecting on their current wellbeing, Kai and Everly respond:

“I would say that my mental health is okay currently. The problem that I will be having soon is the exams, presentations, and evaluations that are coming up. These kinds of assignments are the ones that test me the most and are the most uncomfortable. They can produce so much anxiety that sometimes I would rather just quit than to do them at all.”  
–Kai

“Other than being a fair bit unmotivated in general, and somewhat anxious about the short-term future I am overall in a good state of mental health and general wellbeing.”  
–Everly

Literature on primary school students has identified that effective coping strategies can be used to support students’ feelings of belonging [48]. Engineering programs can support students in connecting the coping strategies that they have learned to help support or manage both their feelings of belonging and wellbeing.

**Feelings of Belonging in Co-op Stem from Relatedness, Lack of Feelings of Belonging stem from Lack of Knowledge or Experience.** The psychological need for relatedness, as identified in self-determination theory [1], frequently occurs in student reflections. Students who have strong experiences of relatedness, particularly during co-op experiences, indicate strong feelings of belonging in their co-op and in engineering:

“The only time I feel like I don’t belong in a group of people is when they don’t make me feel like I belong. If they are being rude or not including me in things.... I feel like I belong in engineering because I feel like this is something that I was meant to do. I also feel like I relate really well with the other engineers and have similar interests.” -Shelby

These findings support existing literature that indicate engineering students express feelings of belonging when connecting with others [20]. When expressing when they feel they do not belong, students describe lack of experience or time on the job as being the root cause:

“I feel as though the main source of the lack of belongingness I feel is due to my lack of experience.” -Aiden

“At work I do have the difficulty of being the youngest one in the engineering department. It is understandable considering I am one of the two engineering interns. The other intern has about a year and a half more experience at the job than I do. It can be a little overwhelming having the least amount of abilities on the team in regards to specific workflow and procedures.” -River

Student engineers on co-op also experienced feelings of imposter syndrome. Imposter syndrome is the term for the feeling of being inadequate even when external evidence points towards success, and often includes a fear of being exposed as a fraud [49]. In Bell, students have workshops explaining what imposter syndrome is and root causes. River further discusses that this feeling of lack of experience is likely imposter syndrome:

“The source of the lack of belongingness can be rooted really deep. I have spent a lot of time over the past few years reflecting on my imposter syndrome and my flaw of never feeling good enough in a lot of instances in life. I believe the source may be the same reason I have always felt this way in life.” -River

Helping students manage imposter syndrome while on co-op has less straightforward solutions. Some cite the need for cultural change to improve feelings of imposter syndrome rather than asking students to use coping mechanisms to handle the symptoms [49]. In a workplace setting, cultural change can fall heavily on the supervisor [50]. One project-based learning engineering program has implemented regular survey distributions to track imposter syndrome, using Godwin’s [2] identity measure [51]. This method may be useful for engineering co-op programs.

These feelings of lacking experience or imposter syndrome also occur in comparison to others:

“Honestly it might be that imposter syndrome. I feel like I’m not good enough, feel like my effort will be wasted as someone else might have the same idea but better. I understand that I should be just going through with it and understanding I should take pride in what I develop, it’s just hard to come to terms with it when there’s so many other amazing people out there.” -Rowan

Belongingness is deeply rooted in the connections with others, and for these students, this frequently appeared as relatedness or imposter syndrome. These discussions also occurred in the broader context of the engineering community, not just those co-op students have frequent interactions with. For example, Finley describes feeling a pride for being part of the engineering community as a whole:

“In the engineering profession, I am proud of being a student engineer and being a part of the engineering community. I enjoy contributing my share in different design projects and achieve something great. I feel like I can make a difference in the future if I keep working hard toward my engineering career.” –Finley

Making a difference or helping others is a frequently cited career outcome that engineering students describe as a goal for pursuing an engineering degree [52], [53]. In the Bell program, students are encouraged to approach engineering as “difference makers.” These phrasings may help encourage or support students’ feelings of belonging in engineering, by connecting to these long-term goals or career outcomes of making a difference and helping others.

**Students on Co-Op Seeking stability through Routine.** In addition to concerns about experience or imposter syndrome, students frequently identify the need to establish a routine to help improve wellbeing.

“I feel that my mental health overall is very good at present. I can gauge how well I’m doing by how healthy my day to day practices are, such as healthy eating, getting enough exercise and sleeping well. Any changes to these practices generally presages a change in my mental health.” –Jaylen

Students in the Bell program are completing coursework while attending co-ops, with their coursework closely integrated with their engineering project experiences on co-ops, but this process of switching between schoolwork and co-op work is not unique to Bell and would be experienced across co-op programs. The process of switching between schoolwork and co-op work and switching between co-ops and moving can cause lifestyle changes. Students recognize when those routines have been lost and need to be re-established:

“My mental health has been relatively okay recently. I’ve had to deal with the usual type of stress that comes from my workload and other issues I’ve discussed before (sleep, diet, etc), but so far the second half of this semester has been better than the first half, and notably better than the end of last semester....That said, the second half of April through to the first week of May is looking to be pretty stressful as various school and work priorities come to a head, so I’m a little tense about that.” –Zion

Workload is a common contributor to student wellbeing. Previous studies have identified that the amount of work, particularly work that students do not find value in, often called busy work, can cause feelings of being overwhelmed [54]. One unique aspect of this program is the pacing of 1-month long technical competencies. Although great care is taken in maintaining consistent timing of class meeting times and assignment due dates, students identify this pacing as an element they struggle with:

“While I was at my junior college I dreaded the start of the classes but I looked forward to the end. Now I dread the start and end because there is another class directly after that.

This is where my mental state goes awry but other than this exact circumstance everything else seems to be genuinely okay.” –Jude

Studies have identified changes in habits such as sleep, daily fitness, and social interactions had significant effects on wellbeing [55]. University students across the world were experiencing disruptions to their routines around this time, due to the COVID-19 pandemic, which was shown to have effects on mental health [55]. In reflecting on their health, students frequently site the pandemic as having impacts on their exercise routines:

“It’s not a habit, it’s a lifestyle. Before Covid hit, I was working out every night and eating healthy. Now I do what I can at home to stay active and workout.” –Charlie

“I would like to start going to the gym again. I stopped going when COVID began and I have not gotten the chance to get back since. I think that working out did very good things for my mental health and going back to the gym would be beneficial for me.”  
–Alex

“I really would like to get back into going to the gym and exercising. Before the pandemic, I was following a strict program and running around 20 miles a week.... Once quarantine started and gyms began to close I lost about 15 pounds from not getting an appetite from the lack of exercise. This year I plan to get back to that routine and keep moving forward.” –River

**Act of Reflection as Beneficial.** Finally, we’d like to note the richness of data coming from student reflections in a curriculum where students are regularly asked to reflect and the benefit of reflection on learning is discussed. The results highlight the value of reflections to help researchers and practitioners better understand student wellbeing and thriving, but students also indicated that the act of reflections were beneficial to overall wellbeing:

“The [reflective activities] sometimes do serve as a good coping strategy.” –Elliot

“Typing everything out is almost therapeutic when I get going.” –Maeve

With these reflections occurring regularly throughout the program, reflections could be used as a tool to help mitigate student stress at key points in the program. Students recognized in their reflections that wellbeing changes frequently with time and context:

“My mental health is not at a peak, but it is climbing now, so I’m no longer in the valley.”  
–Jade

“I would say the state of my mental health and wellbeing are at a fairly good spot right now. Mental health is something I have struggled with in past years, and I still feel a little down sometimes but I have learned to deal with things better since then.” --River

## **Conclusions**

Through analyzing student reflections on their health, wellbeing, and belongingness, we have identified the types of coping strategies used by students, students' perceptions of the connection between wellbeing and belongingness, the need for routine healthy practices, particularly while on co-op, and reflection as a coping strategy.

**Implications for Practice.** Our findings support the idea that wellbeing is very contextual and ways to improve wellbeing highly depend on the individual [19]. In supporting students' wellbeing, there is not one solution that will work for everyone. Instead, we suggest that providing students with a wide variety of resources and coping strategies, scaffolding through workshops and reflections, will help support students in identifying strategies that work best for them. The reflections have indicated that if we discuss strategies, they will identify which strategies work best for them. Through mentorship to help support students in finding these strategies and developing plans to maintain those. Further, defining wellbeing to include belongingness, may help further support students in utilizing coping strategies in a wider variety of contexts, outside of coursework.

Providing students with the opportunity to reflect will help support students in identifying coping strategies and consider their own wellbeing. By asking students to consistently reflect, ability to reflect strengthens. When applying these prompts to your own students, particularly students who are not used to being asked to reflect in engineering classes or do not have a description of why, the reflections may not be as rich or open.

**Implications for Research.** Our findings have supported and contributed to existing literature on student thriving. The work here has identified student reflections as a useful tool for practice, but also for gaining insight into students' perceptions of wellbeing. We believe that with the right contextual implementation these reflective prompts and corresponding codebook may be useful for implementation in a variety of contexts. We believe this codebook may also be beneficial for practitioners to use or consider when implementing these reflections or similar reflective tools as a way to critically examine student responses and consider implications for programmatic improvements.

**Future Work.** The scope of this study was narrowed by our research purpose, what students chose to include in their reflections, and theoretical frameworks. However, in reading the

reflections we recognized the further potential in the data, including exploring the contribution of motivation and mindset to student thriving (i.e. growth mindset and locus of control). These reflections did occur over a period of three months, and as such we saw some room for exploring wellbeing longitudinally. It was clear from the reflections that students recognized that wellbeing is contextual and changes with time; there is room for tracking wellbeing over time through reflections. This could help further inform programmatic changes, such as identifying times of higher stress through the program and how to distribute those more evenly. Additionally, the opportunity for follow up questions, or including reflective prompts for students to connect wellbeing and belongingness could be beneficial.

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## Appendix A: Reflective Prompts

### “Health Reflection” (Month 1 Assignment)

- Employing good habits, such as eating right and exercising, can be beneficial in many ways. What is one healthy habit that you employ for your physical health? Why do you employ this habit?
- What is one healthy habit that you employ for your mental health? Why do you employ this habit?
- What is one habit you would like to begin and maintain? Describe your plan to accomplish this?
- What questions or comments do you have?

### “Wellbeing” (Month 2 Assignment)

- Reflect on your current state of mental health and general well being. Describe anything you are willing to share here.
- Since the beginning of the semester, what coping strategies have you used when times get tough? Which coping strategies have helped?
- Which coping strategies have you tried that have not helped?
- What other comments/ideas do you have?

### “Belonging” (Month 3 Assignment)

- Belongingness is a key part of engineering identity and retention in engineering. Describe a few ways in which you feel like you belong in either the engineering profession or your current position/project.
- Describe a few ways in which you feel you don’t belong in either the engineering profession or your current position/project.
- Really think about it, and discuss what you feel the source of that lack of belongingness may be.
- In what ways can you move forward to improve your belongingness?

## Appendix B: Finalized Codebook

Below is the finalized codebook used to analyze the responses to the reflective prompts listed in Appendix A. Note that managing workload falls under the umbrella of self-regulation; however, as managing workload was explicitly discussed with students frequently in workshops and was brought up frequently by students, this code was kept separate from self-regulation.

Category	Code	Definition	Example	Notes	
<b>Coping Strategies:</b> Items that student identified specifically as coping strategies, or actions they can take to improve overall wellbeing.	<i>Indicate + or - for identified as helpful (+), or not helpful (-)</i>				
	1	Intrapersonal reflection	Student describes activities that involve focusing inward, such as positive thinking, meditation, and prayer		
	2	Interpersonal reflection	Student describes activities that involve interacting with additional individuals, people or pets, specifically activities that require another individual, such as seeking advice, therapy, helping others, or venting	"I usually seek advice from those close to me that I trust asking personal questions"	
	3	Physical Maintenance*	Student describes activities that directly impact their physical being, such as medication, exercise, sleep, drinking water, and eating healthy	"One thing I need to start doing is eliminating all of the junk food I am surrounded with"	
	4	Managing Workload	Student describes taking actions directly related to changing the amount of work they have, such as powering through or taking time off, including procrastination.	"I usually do what I want when I want, meaning if an activity at work isn't currently bringing me joy, I'll happily switch to another task that is."	Note that this also fits within self-regulation, but is identified separately, as it is taught frequently and separately in workshops at Bell
	5	(Activities for) Fun	Student describes doing an activity that is outside of work/effort and focused on the fun of doing it, such as relaxing, hobbies, or binge watching.	"The best strategy that I've known to work for me is to give me time to destress, usually on a single day I use that day to do absolutely nothing but relax, usually Saturdays"	
	6	Changing Location	Student describes an activity specifically related to going to a new location such as spending time outside, travelling to new places, or driving around.	"I think that the best coping strategy when dealing with work-related anxiety is to write down any tasks that you are responsible for completing."	
	7	Self-Regulation	Student describes ability to plan, direct, and control one's emotions, thoughts, and behaviors during a learning task, such as visualizing long-term goals, creating a list of tasks, or time management strategies	"I wrote a list of goals I will achieve this semester and I continue working toward meeting them. I picture how happy I will be when I am successful and how disappointed I will be if I should fail."	SRL
<b>Why behind coping strategies:</b> Students describe the goal of coping strategies, not focused on motivation rather than action	8	Evaluating/Monitoring	Student describes study strategies related to monitoring their own progress on tasks, such as tracking their motivation, acknowledging when work is done.		SRL
	1	Long Term Focus	Student describes prioritizing a long term goal or benefit, particularly over short term outcomes.	"The biggest part is thinking about your long term goal versus the short term satisfaction that unhealthy food or drink will give you."	
	2	Shifting Focus	Student describes the activity as a way to help gain a new perspective, such as distractions, visualizing goals, or getting outside input.	"For some reason, it relaxes me and provides a distraction from everything that is going on."	Note that the opposite would be an activity that causes them to ruminate or overfocus on one thought.
	3	Momentum	Student describes the activity as a way to gain motivation or momentum for completing other tasks, such as getting jump start on the day, or	"I can do a short activity as an emotional palate cleanser to keep earlier negativity from impacting the rest of my day/night"	
	4	Autonomy	Student describes the reason they use a strategy is because the do or do not have control over the task.	"Napping is also another thing I do in order to get a little burst of energy. Yeah it uses some time of my day, but it does help me recenter myself."	
<b>Stressors:</b> Things that cause the student stress, or that stressors can be possible in the form of "excitement"	5	Comfort	Student describes doing activities that are comfortable or familiar, such as using certain coping mechanisms because that's how they have always done it.	"If it were my choice and not something that was required, I wouldn't be doing it."	
	1	Isolation	Student describes isolation, minimal social interactions, loneliness as a source of stress, for example, living alone.	"I tend to fall on unhelpful strategies rather than the one I know will work because it requires humility and surrender."	
	2	Workload	Student describes the amount, types/variety, or timing of different tasks as being a source of stress, including having a variety of tasks to balance.	"Living on my own for the past two months has given me some struggles"	
	3	Social	Student describes social interactions as a source of stress, such as personal relationships	"There's a lot going on right now and my brain has information overload with almost 0 motivation. I want to get things done but I don't, which eventually brings nothing but bad for me."	
	4	Generalized Anxiety	Student describes generalized anxiety, or anxiety that does not have an identifiable source as a cause of stress.	"I was a little stressed before because of my personal relationship, but hanging out with my friends helps a lot."	This is different than a student not wishing to share the source or being intentionally vague for privacy. We do not code those.
<b>Belongingness:</b> Things that students recognize as being what support or oppose their feelings of belonging in engineering	5	Physical	Student describes physical ability as a source of stress, for example an injury.	"I fell off of a ledge while hiking with friends. I landed on my ankle and broke it."	
	1	Interest	student describes being interested in the field/discipline/or tasks	"I wake up every morning excited to go to work."	
	2	Recognition	student describes feeling recognized by themselves and others as an engineer [cite]	"I also feel like I relate really well with the other engineers and have similar interests. Other than that, I feel like I belong wherever I go, especially when I get along with everybody."	In literature this is referred to as performance/competence [cite]
	3	Performance	see themselves as competent and capable of performing engineering tasks	"At work I do have the difficulty of being the youngest one in the engineering department"	This and performance can be similar to imposter syndrome.
	4	Experience	Student describes the amount of time an individual works in engineering as being a part of belongingness		
	5	Difficulty	Student describes feeling like they belong because of the culture of difficulty in engineering, for example being excited by challenges or feeling respected because of doing difficult work.		
	6	Relatedness	Student describes seeing attributes of themselves in other engineers, or connecting with the people they work with in engineering. [cite]		Also discussed in terms of social safety.
<b>WellBeing:</b> Definitions or characteristics of wellbeing	7	Imposter Syndrome	Student describes imposter syndrome by name	"Honestly it might be that imposter syndrome. I feel like I'm not good enough, feel like my effort will be wasted as someone else might have the same idea but better. I understand that I should be just going through with it and understanding I should take pride in what I develop, it's just hard to come to terms with it when there's so many other amazing people out there."	Since students were specifically taught the term, only code if imposter syndrome is described by name or by definition.
	1	Managing Stress	Student describes wellbeing as how well they can manage stress		
	2	Physical or Mental	Student describes well-being as either being physical health, mental health, or a combination.	"As far as general well being goes I will connect that to physical health"	
	3	Changes with Time	Student describes well-being as changing with time.	"It's easy to feel down when you're not treating your body correctly"	
	4	Changes with Habits	Student describes well-being as something that can change based on behavior, particularly behaviors that are recurring and described as a habit or lifestyle	"I think that having a routine and following it, never allowed me to fall behind in anything I was doing. ... The reason why I sound uncertain is because I never had any tough times so I think that doing these things allowed me to not have them."	
5	Productivity	Wellbeing is defined as able to continue completing tasks and the work that needs to be done.	"Right now I feel like my mental state is pretty strong. I'm carrying on my tasks as needed, working through any problems that seem to arise, and getting applications sent out"		