Experiences of Undergraduate Robotics Engineering Students with Rest and Work-Life Balance in Academics

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Abstract

In pursuit of understanding the experiences of Robotics Engineering (RBE) majors at a private STEM institution, our study aimed to explore what are these students’ experiences with rest and work-life balance when taking part in the program, what aspects of these courses have improved their ability to balance work and rest, and what perspectives are there on changes that can be made in the future to help students manage work-life balance. Two focus groups were run with students from the RBE program at a private STEM institution, consisting of seniors and sophomores respectively, with a moderator guiding discussion on these topics. The following themes were found in discussion to interact with these experiences: Division of Task Appraisal; Social Dynamics and Perceptions; Fluctuating and Challenging Curriculum; Variations in Support; and Before and Beyond the Degree. To enhance student experiences with rest and work-life balance while part of this program, we discuss where these themes had negative impacts on these experiences, and where positive experiences can serve as an example to model from in the future.

Keywords: robotics engineering, rest, work-life balance
Experiences of Undergraduate Robotics Students with Rest and Work-Life Balance in Academics

Rest and work-life balance are important aspects of wellbeing (Pookaiyaudom, 2015). It is able to help reduce depression and shield individuals from harm caused by work demands (Joudrey & Wallace, 2009) Undergraduate students, between their academic work and other responsibilities, are no exception (Picton, 2021). Leading into this study, Robotics Engineering students at the studied institution had a reputation of being all work and no rest. While not necessarily an issue specific to RBE students, this strong stereotype made them an ideal group to evaluate in regards to their experiences with rest. Studies performed on university-level students at other institutions, in STEM majors and beyond, have found a desire for more balance in the academic environment (Loshbaugh et al., 2006, Martinez et al., 2013). Sleep and academic stress, both factors affected by rest, have been found to be inversely related to student performance, as the effects related to health and well-being can improve focus, concentration, and overall behavior (Gregory, 2021, Lewis, 2012, Centers for Disease Control and Prevention, 2019). By contrast, problem- and emotion-focused coping and academic motivation have a positive relationship with student performance (Struthers, 2000), though the emphasis on learning over motivation in content preparation is a known from prior research to be a common contrast between formal and informal STEM and Robotics curriculum (McKay et al., 2013). Despite the positive effects of rest on learning and productivity, it can be the first thing dropped when other time pressures present themselves (Cat-Admin, 2020, Beddoes & Danowitz, 2021). This can lead to a cycle in which lack of rest leads to less productivity, leading to more work and less rest in turn.

The benefits of work-life balance build on this, as time dedicated to study and rest is needed to support both statistical and high-order rule learning, and taking breaks allows for creative incubation periods and time for memory consolidation (Quentin et al., 2021, Ritter & Dijksterhuis, 2014, Wamsley, 2019). The concept of a work-life balance\(^1\) is currently in dispute (Lewis et al., 2007, MacInnes, 2006, Underhill, 2022), so to clarify the usage of this term

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\(^1\) Work-life balance is also seen in literature, especially regarding university students, being called or included in: Study-life balance (Hatcher & Hwang, 2020), work-study-life balance (Vokić et al., 2015), study-work-life balance (Mahler, 2020), work-life and study-life balance (Chansaengsee, 2017), work/study life balance (Kumar & Chaturvedi, 2018), life balance (Loshbaugh et al., 2006), and, while highly critiqued as outdated, work-family balance (Clark, 2000).
through this study: Work-life balance is being used in this study to discuss the balance between academic work and studies and non-academic tasks and activities, where the ideal balance is not an equal distribution throughout these aspects as commonly defined in the popular early literature on this (Greenhaus et al., 2003), but a self-defined equilibrium in the relationship between these aspects (Vokić et al., 2015, Kossek et al., 2014, Clark, 2000, Hughes & Bozionelos, 2007, Kalliath & Brough, 2008, Kelliher et al., 2018, Hill et al., 2001, Quick et al., 2011, Dhas, 2015).

With rest and work-life balance being crucial to student learning due to increased memory retention (Dewar et al., 2012), positive effects on physical and mental wellbeing (Centers for Disease Control and Prevention, 2019), and problem-solving, we aimed to investigate what the reality of the negative stereotypes revolving around rest and work-life balance in the RBE program is. The first research question we asked to address this was “What are robotics engineering students’ experiences with rest?” to compile and document how this may show up. From there, the second research question we asked was “What aspects of robotics courses have improved students' balance with work and rest? What changes can be made in the future to help students manage work/life balance?” to explore student perceptions on how these experiences can be enhanced, as professors can act as mentors for each other, allowing for examples provided to be used as models to replicate in future classes (Mawhinney, 2010, Lieberman & Pointer Mace, 2009), and while students can struggle with identifying how they study best (Gernsbacher et al., 2015), there are many elements to structuring academics that students can still recognize to be an issue. As a preliminary exploration into this specialized topic, we conducted the study as a focus group to capitalize on the benefits of this qualitative method of study, such as gathering data on the culture within this participant group and identifying statements with significant agreement (Gibbs, 1997). We predicted a combination of common academia stressors - such stress from academic failure coming from the threat to a student’s financial situation and GPA - and stressors unique to this school and to this program - such as stress caused by issues with the structuring and implementation of course curriculum - to play a heavy hand in what keeps students away from rest and causes a lack of satisfaction in the resulting work-life balance.
Method

Participants

Nine Robotics Engineering majors participated in the focus groups (4 Sophomores; 5 Seniors; 67% male; 11% female; 22% non-binary). Participants were mainly White (67% White, 22% Asian, 11% Other). All participants gave Informed Consent upon arrival in their respective focus group session, and gave consent to being audio recorded for transcription purposes. Data on respondents to the sign-up survey that were not selected for the focus groups, and therefore did not fill out informed consent, was not retained and is excluded from all data sets. Participants received a $20 gift card for their participation.

Materials

Experiences with Rest

An outline to guide focus group discussions was developed to ensure consistency in what discussion revolved around between the sessions. When assessing participants’ experiences with rest, the following questions on what was considered to be rest or productive/unproductive activities, a definition of rest would be provided to encourage consistency, and following questions on the frequency and types of rest participants engaged in, participants were encouraged to recall experiences distinct to taking RBE courses to lead into the question on how their experiences vary from that of their peers when taking RBE courses.

Practices that Improve Work / Rest Balance

The remaining questions, which assessed what aspects of Robotics courses have improved students’ balance with work and rest and changes that can be made in the future to improve this balance, asked about positive examples of when professors or hired assistants had supported this balance, the balance of work and rest during RBE courses and the factors affecting that, and recommendations on changes to improve this balance were determined to be unambiguous enough for clarifications to not be necessary. The outline of focus group questions and clarifications is elaborated on in Appendix B.
**Procedure**

To recruit participants, the focus group sign-up survey was sent to contacting lists of the degree of interest, and had no restrictions on being shared beyond these communications. Respondents were asked their name, school email address, grade year, expected graduation year and time availability to be contacted if selected for a focus group session, and had the option to respond to demographics data on age, gender, ethnicity, and history of participation in RBE classes. This survey was designed in Qualtrics, with an exported copy of this being seen in Appendix A.

To assess what this institution’s RBE students’ experiences with rest are, questions were designed to discuss what participants considered to be rest or productive/unproductive activities, the frequency and types of rest participants engaged in, and how their experiences vary from that of their peers when taking RBE courses. When looking into what aspects of Robotics courses have improved students’ balance with work and rest, and changes that can be made in the future to improve this balance, questions were designed to discuss positive examples of experiences participants had in the past where professors or hired assistants had supported this balance, if they felt that they could balance work and rest during RBE courses and the factors affecting that, and what the changes are that they would recommend for improving these areas. Given the nature of this being a preliminary study, allowing flexibility was included in the design to ask questions prompted by a session’s discussion.

To gather participants into focus groups of peers in the same year of the degree, a sample was selected of senior and sophomore respondents respectively to participate in a focus group session, given the overlapping availability in time for respondents in these groups. This study was conducted on a private institution’s campus during the fourth quarter of the school year. Participants gave informed consent at the beginning of the focus group session they participated in, agreed to being audio recorded for transcription and quoting purposes, and were presented with food and drinks to create a comfortable environment for discussion. After the focus group moderator and note-taker both introduced themselves as researchers, participants took part in a discussion for the duration of the session, where the moderator guided them through the designed questions. Participation in this discussion included verbalized responses, raise of hands responses, and interpersonal dialogue. Appendix B presents the outline of Focus Group Interview
Questions (Appendix B). At the end of the focus groups, participants were debriefed and thanked for their participation, with the compensatory gift cards being sent at a later time.

**Data Analysis Plan**

The focus groups were recorded and transcribed. They were then analyzed using thematic analysis. This started with familiarizing ourselves with the data, rereading transcripts and listening to recordings. From here, we worked to code our data, linking participant’s responses to our research questions. When responses touched upon a theme, they received coding which reflected the way in which the two connected.

For research question one, we coded for quantity of work, quantity of rest, barriers to rest, types of rest, and perceptions of rest. Research question two involved coding for curriculum’s impact on rest, balance of work and rest, and types of changes that could improve rest. After coding was completed, initial themes were found from coded transcripts by combining common and frequent codes, and then were refined. Themes were then reviewed and named (Braun & Clarke, 2006).

**Results**

Following the focus groups, recordings were reviewed and analyzed using thematic content analysis, and the following five themes were identified from coding: (i) division of task appraisal; (ii) social dynamics and perceptions; (iii) fluctuating and challenging curriculum, (iv) variations in support; and (v) before and beyond the degree. We elaborate on each of these themes below.

**Theme 1: Division of task appraisal**

This theme encapsulates how participants tied their experiences of academics and rest together, from how they categorized a task, to how time spent on rest could not involve academics (or vice versa), to feeling that they are stuck with spending their time on academics over rest. Under this larger theme were three sub-themes: productivity in life, academics, and rest; separation of rest and academics; and stuck in academics.
**Productivity in Life, Academics, and Rest**

Participants were asked to describe productive and unproductive tasks, as well as rest. In both focus groups, participants emphasized a distinction between academic productivity and life productivity. Among five participants, examples of academic productivity included: making progress on academic/school work and assignments, homework, studying, working on (a class’s) robot, and making progress on code. Among six participants, examples of life productivity included: running errands, general life maintenance and human needs, cooking, doing groceries, doing laundry, doing dishes, tidying up, and voting.

When rest was brought up by participants in the discussion on productivity, it was seen as something that could be situationally productive. Only one participant classified a restful activity as productive proactively, and two participants initially classified activities that were at separate times identified as restful to be unproductive, but rest was classified as situationally productive by in these three instances, with another participant pitching in agreement as well, when engaged with a question on it directly. A 30-minute break was identified as being productive and restful due to its long-term benefits to overall productivity, and rest was identified as something that can be productive if it stays within boundaries; however, guilt was identified as something they could feel when taking time to rest for ‘not being productive’, as well as identifying feeling that rest *should* be viewed as productive, but usually was not.

“... if you have other requirements to do, like school work… if you take a break from that, it feels unproductive because you could be doing other things. Whereas if you don't have other work to do, it might not feel that way.” (Sophomore 3, nonbinary)

**Separation of Rest and Academics**

Participants were much less divided on whether academic work could be restful. Between both focus group sessions, all participants expressed or agreed that an activity involving academic work could not be restful, going as far as to define rest as the absence of stressors from academic work.

“Rest is also… not having anything pressing, or- I don't have anything, any long-term projects, and nothing due in two days: That's rest.” (Senior 1, male)
This was expanded on by three participants, who respectively pointed out how the threat of work looming over them could make an otherwise-restful task less restful.

“When I recharge the best is when I’m in a situation where there’s nothing over my head… - which, obviously is never like fully the case, there's always something on the horizon” (Senior 5, male)

When participants were asked to share through a raise of hands how regularly they engaged in rest, responses from the senior group ranged from three to seven times per week, and responses from the sophomore group ranged from seven to twelve times per week. The variation in responses may be due to a clarifying question in the sophomore group about if sleep counted as rest, and should be included when responding to this question, providing a reminder that was not presented for the senior group when answering this question. Even with this in mind, one senior did maintain getting rest every day, while two sophomores confessed that the inclusion of sleep in rest would mean getting rest at least seven times in a week does not apply during finals week. When participants were asked if they felt they got less rest than their non-RBE peers when taking RBE classes, there was universal confirmation that they do not throughout both focus groups.

**Stuck in Academics**

Participants shared experiences where academic tasks would force even life tasks that they identified as productive to take a back-seat. An example of this that was met with agreement from those in the session was expressed through a sentiment:

“The second I start putting my mental health first is the second I start getting behind in the class. Like, if I try to start… going grocery shopping, doing laundry, or anything after, I get behind” (Senior 2, female)

Expanding on examples of this, lack of eating as an issue that RBE students struggle with was independently expressed within both focus groups, and was met with no disagreement, but rather significant affirmation through verbal and non-verbal expressions and sentiments, with this issue being affiliated with the high quantities of work and policies surrounding food in the lab.

Time spent on academic work encroaching on the time available for life activities became even more pronounced when rest was considered in the presence of academic stress.
“... if you want to get an extra x amount of sleep, that means your grade is going to be going down proportionally… maybe you can eek out a little bit here and there, where it doesn't affect it, but like… Any more than a little bit, and you know you’re in deep trouble.” (Senior 4, male)

**Theme 2: Fluctuating and Challenging Curriculum**

This theme covers the academic situations being appraised that were found to be stressful - from experiences with inconsistencies in curriculum pacing that could be further disrupted by an unfavorable change, to those where participants felt overwhelmed by the constant work with seemingly unreachable goals - with the demands of academics, stress of the work, and threat of failure affecting how much time they had for rest. Under this larger theme were three sub-themes: curriculum variability and reliability; constant work and ambitious goals, and; pacing and lab-work.

*Curriculum Variability and Reliability*

Participants expressed frustration in sudden, unfavorable curriculum changes. When professors made errors in pacing or other course work, participants felt as though they were punished for it, cramming more work into their already busy schedules. One participant shared:

“My professor realized we had one less Wednesday in the term… So (he) was like, “You know what? I'm just gonna take Lab 3 and Lab 4 - which are both these two-week labs - and combine them into one three-week lab… And just say good luck” (Senior 3, male)

By contrast, a steady, reliable curriculum was viewed as a way that professors positively affected the ability of students to balance work and rest regularly. Examples included professors encouraging consistency in effort and time students had to dedicate to coursework through simplifying how many assignments students would be attending to at a time, calendars with upcoming assignments and deadlines, and professors ensuring consistency in assignment materials with clear objectives, expectations, and tasks that needed to be done.

*Constant Work and Ambitious Goals*

Even without additional work through curriculum changes, participants expressed feeling overwhelmed by the amount of work expected of them when taking RBE classes, and that this
quantity of work limited their ability to take time to rest. Participants in the senior focus group universally agreed that the workload of RBE classes contributed to less rest and on how the workload would regularly require working until the last minute, all within the session sharing or expressing or endorsing stories and frustrations about this last-minute rush to finish assignments such as the labs and final projects. Participants also felt that the goals set before them were often not realistic, and that working towards these ambitious goals negatively affected their work-life-balance.

“Yeah. You know, you can go in every day, but you're not guaranteed (to finish/succeed).” (Senior 3, male)

Being forced to go into the lab every day and still have the threat of failure looming over them was a source of frustration many participants agreed on, and these ambitious goals would regularly lead to long, seemingly non-stop sessions of academic work.

Participants identified difficulties with the readability and comprehension of assignments that would often amplify these issues, suspecting that labs and curriculum materials were outdated and to blame for this. For example, one participant stated:

“... the labs just don't make sense - It's not like people don't understand, but they were old labs, and they haven't been updated, and things don't work for everyone… It’s just right off the bat, there’s so many problems.” (Senior 5, male)

Two participants did express gratitude for the flexibility professors had when goals were not met, while simultaneously highlighting the nature of how these goals are unmeetable in the first place. A participant highlighted this, sharing:

“But I do think the professors kind of expect it to not be fully complete… They're not super strict… It’s not like if you don't get all of the requirements, that you will get anything - You can still get points by making some part of it, there’s still leniency there.” (Senior 4, male)

**Pacing and Lab-Work**

Some participants expressed frustration with the pacing of the course, and the labs in-particular. They described frustration that many labs built directly off each other in such a way that falling behind became a constant negative feedback loop. One student explained:
“Most of the classes, if you don't finish the lab that week, you have to finish it in order to start the next lab, so then you're behind on the next lab for you to finish it. So, it's not only that I don't want to let other people in my group down or force them to do more work, but if we don't do it then, it just gets even worse later, so we don't really have a choice.” (Senior 4, male)

However, it was noted with agreement from other participants that if labs are carefully structured to safely escalate through the term, then, especially if they build into the final project, this can by contrast be very beneficial, such as in the following.

“If the professor knows how to structure the class well, they'll make sure that you're not doing everything the last week… Whereas if the professor doesn't know what they're doing, you kind of just learn things as you go, and then the last couple of weeks you're doing it all” (Sophomore 2, male)

Theme 3: Social Dynamics and Perceptions

This theme highlights issues that occur in RBE’s social atmosphere, team dynamics, and the effect on mental health, and is the first of three themes that revolves around factors that could augment their appraisal of these situations or play into if they could cope with or had the resources to handle difficult situations. Under this larger theme were three sub-themes: student culture; a student’s effect on the team; and the team’s effect on a student. Every participant of the senior focus group agreed to feeling pressure about grades, that there is social pressure due to the nature of group-work in RBE, and that the ‘grind culture’ and bragging competition about a lack of self-care lead to decreases in rest.

Student Culture

Participants described a bragging contest when it came to lack of self-care within the RBE student body, which made it difficult to rest. One participant noted;

“I think another part of it is the social pressure, where everyone’s saying like, ‘Oh I got only two hours of sleep last night,” that was a bragging thing? But… It's like: If you're not doing that, you're not meeting the requirements of the class… which I don't think is a very positive thing. I just think that’s preventing… Rest.” (Senior 4 male)
Participants expressed difficulty in justifying their own rest and self-care when others made a point to highlight their inability to do so.

*A Student’s Effect on the Team*

The STEM university’s RBE classes focus heavily on group work; with students working in the same small group throughout the term, building up to the final project. Participants explained how working in teams impacted their ability to maintain a healthy work-life balance, and that they feel a commitment towards teammates.

“If my own grade has to take a hit, I can make that my decision, I have good grades, I know how much of the hit I can take… Maybe I’d be better off if I ask them, ‘Hey, what kind of grade are we looking for on this assignment?’ But it's usually just the social impetus… I have to at least meet their commitment, and I'm sure that they're doing the same in reverse…” (Senior 5, male)

*The Team’s Effect on a Student*

Focus group participants were explicit about how their teammates can affect their ability to maintain a healthy work-life balance. When discussion in the focus group prompted a question to confirm that a team can affect a student’s ability to balance work and rest, participants responded with avid agreement.

“... I was stuck with all the code on my team… I had a CS double on my team, but I still… did most of the code… I ended up like pulling a 40-hour all-nighter…”

(Sophomore 4, male)

While focus group participants expressed a strong desire to excel due to the nature of team-work, many of them felt their partners did not always do the same. Participants from both focus groups shared stories of where a member on their team was unwilling or unable to pull their weight within the group, causing more work for them on top of an already challenging curriculum that would further limit their ability to engage in rest.

“... [teammate] was a CS/RBE double major. He's like, ‘I'm not really great with anything but code, but I'll handle all the code when we get there,’ and… He did not handle the code… He gives it to us three days before the thing’s due, and it's not even close to what it had to be… Those were the worst three days of my life.” (Sophomore 1, nonbinary)
Theme 4: Variations in Support

This theme discusses the disjointed feeling between lectures and labs, TAs and SAs being the buffer to failure, and feeling their in-class learning went unsupported due to misaligned assumptions on student background experience, and is the second of three themes that revolves around factors that could augment their appraisal of these situations or play into if they could cope with or had the resources to handle difficult situations. Under this larger theme were three sub-themes: labs versus lecture; classwork assistants, and expectations on prerequisite learning.

Labs Versus Lecture

The lecture and lab content were described as feeling disjointed. The following statement got two piece of verbal and one piece of non-verbal agreement,

“I don't know if it's just me, but does anyone else feel like… the lecture content is completely different than the lab content?” (Sophomore 1, nonbinary)

This disconnect caused frustration, as participants felt they were not always adequately prepared for the labs due to differences with the lecture content, which led to longer work-hours that further intervened with their ability to engage in rest.

“If they're disconnected, but we're treating it as one course, it's kind of silly… Either one or the other: Either they're two courses, or they're one, but you need to teach things.” (Senior 3, male)

“… the labs… are much more time-consuming because there's this huge disconnect in RBE between labs and lectures…” (Senior 1, male)

Classwork Assistants

As there were rare instances where the aid provided by these positions was differentiated, if at all, “TAs/SAs” will be used as an umbrella term outside of quotations to reference the collective of roles that supports students specifically in RBE courses: Teaching Assistants (TAs), Student Assistants (SAs), and Lab Assistants (LAs). TAs/SAs were universally seen by participants in both focus groups as a favored option for academic support in RBE, with every participant expressing a history of positive experiences from interacting with them, often expressing personal approval of their work. Participants in the Sophomore focus group
universally agreed that TA’s/SA’s deserve much more than they’re paid, with one senior participant similarly expressing:

“And [TAs/SAs] really will be there in the lab till like 7 AM with the teams… They’re like, “I get paid to be- for like a total of eight hours a week, but I spend about 20–30 hours in the lab will be helping people because I just don't want all these people to fail…””
(Senior 1, male)

Participants explained how the TAs/SAs were instrumental in their success during the course, often going above and beyond their usual duties to ensure students were able to succeed.

“I think the major benefits of the SAs is when a class-wide issue comes up… they're usually the people who are like, ‘Oh, that's a typo, do it this way’ or like, ‘Yeah, I've seen that before… Here's how you fix it… Hey, this is what everybody runs into.’ So, it prevents really common issues.”
(Senior 3, male)

In line with the theme of Social Dynamics and Perceptions, participants also acknowledged that the TAs/SAs are also students, and worried about burdening them too much. One participant shared:

“I feel bad sometimes because… [the TAs/SAs are] students doing their classes and stuff… Asking for help is like a burden on them, too.”
(Senior 4, male)

Alongside this stress of adding to the burden on the TAs/SAs, and in line with the previous sub-theme of Labs Versus Lectures, the overlap between the usage of TAs/SAs and the frustrations with the disconnection between lectures and labs prompted a participant to suggest:

“... I think it would be useful to have a few dedicated SAs just for lecture content so that when you're studying for an exam or something, you can go to that dedicated office hour… because right now, SA and TA are always in the lab but working on lab work, and it can be hard to pull them aside to ask about lecture content…”
(Sophomore 2, male)

**Expectations on Prerequisite Learning**

Participants in both focus groups highlighted the amount of knowledge they were expected to have gained in other places, creating frustration as students have to dedicate more time to academic work in order to learn these independently.
“... so much of the material is… You're supposed to have picked it up from another class… All of these adjacent skills you're supposed to pick up” (Senior 3, male)

“The fact that there's a CAD requirement in [class], where they teach no CAD, is very silly.” (Senior 4, male)

This frustration was brought forward in the conversation when discussing changes to benefit the balance between work and rest in students, with one participant suggesting:

“... obviously this would be a huge adjustment, but - a lot of the material should be covered natively in the Robotics courses that they're requiring you to sort of pick-up elsewhere. That makes the learning curve really easy.” (Senior 1, male)

Four of the seniors expressed frustration with the number of different programming languages they were expected to learn, though two expanded on this to say that they liked the intention behind it, but found the implementation challenging and contributing to more work. However, this perspective was not held unanimously: A positive opinion of these requirements countered that they found benefit in it, as they felt it allowed them to develop the skill of picking up new coding languages rapidly. The following represents a conversation between participants on this:

Senior 3 (male): “So, I like the idea of learning multiple languages, but, like: You don't learn them in a class, you just have to know them, and…”

Senior 1 (male): “It’s trial by fire.”

Senior 3: “Yeah. So, I get the idea of, ‘It's good to learn more languages,’ but if they want to teach you that, that would be cool.”

However, not all experiences with coding within RBE reflected this lack of teaching support in this area, with one student describing their positive experience with an experimental course designed to teach object-oriented programming natively:

“I took an ISP… I will vouch for that course, forever. It's not running… but… instead of doing a CS object-oriented… seeing those robots actually move with all their code… works well…” (Sophomore 4, male)
Theme 5: Before and Beyond the Degree

This theme explores feeling misled by prospective student advertising, the stress to impress potential advisors and employers, and limitations in portfolios, and is the last of three themes that revolved around factors that could augment their appraisal of these situations or played into if they could cope with or had the resources to handle difficult situations. Under this larger theme were two sub-themes: prospective student advertising; and desirability as an applicant.

Prospective Student Advertising

Within the Senior group, participants discussed how RBE was advertised as a three-in-one major, combining Mechanical Engineering, Electrical Engineering, and Computer Science, and how they felt that their experiences in the program did not follow through with what they had been advertised. The importance of motivation and interest in the work being done was discussed in relation to this, identifying how this misalignment causes a learning style conflict when engaging with course content, extending how much time must be dedicated to academic work and further limiting how much time is available for rest. The following represents an exchange that occurred within the focus group:

Senior 4 (male): “I think that there's a major divide between Modern Robotics and… Mechatronics… I think the forward-facing appearance of the RBE department to incoming students is…”

Senior 1 (male): “Is what they see in Foisie [sic] lab.”

Senior 4: “Yeah… A Robotics engineer is just… applied CS; Whereas they present it as this… three-legged chair. I think the advertising of the RBE department is a little flawed… People are forced to learn skills that they are not necessarily interested in, in order to push them towards jobs that is not the fruit that they were looking for.”

Senior 2 (female), with sad laughing: “I agree.”

Senior 4: “And then… this learning style conflict of: It's hard to bring yourself to be motivated towards things that you’re not interested in.”

Disagreement did arise when discussing whether the RBE degree should strive to reflect the three-in-one advertising, or if the advertising should scale back to better reflect the coursework,
when prompted to share about how the program has affected perceptions towards robotics in general. However, the importance of CS within Robotics was viewed as pertinent to the academic and career fields alike.

“... it has shown that, if you want to work in Robotics: Every Robotics job I've had has been programming. I haven't touched a ratchet in years. And I think that that's probably accurate to the nature of the work” (Senior 4, male)

“... If you don't have CS, you can't do anything else; If you don't have anything else, but you have CS, you're fine… It's taken away that three-legged stool idea that they advertised to get you to come here.” (Senior 3, male)

During the Sophomore focus group, while references to differentiating ME and CS aspects in particular were made, neither the concept of the three-in-one major nor the advertisement scheme were referenced.

**Desirability as an Applicant**

The Senior focus group, with many of them working on their Major Qualifying Projects(MQPs) and looking at potentially graduate school, expressed a concern about impressing faculty that was not as prevalent in the Sophomore group. They viewed professors not only as those currently teaching them, but as potential future advisors or research partners.

“... particularly in the junior level classes… because you have to get a MQP… kind of want to have performed well, so as you’ll be an impressive candidate… Like, [Professor 1]… is my research advisor, so I want the professors to not think I’m an idiot.” (Senior 5, male)

In line with Theme 2: Social Dynamics and Perceptions, discussion on these topics identified social stressors that caused participants to feel pressured to spend more time on RBE academic work, and as Theme 1: Division of Task Appraisal discusses, feeling stuck in the labs was identified to limit the amount of time available for rest, and even the stress of academics could reduce or take away from the ability to engage in restful activities.

Both focus groups had individuals express how thoughts of the future impact their current work-life balance, but seniors in particular seemed to be looking ahead to life beyond college, with joining the workforce being a fast-approaching reality. One of the stressors discussed was
these seniors’ portfolios, where participants felt an increase in pressure for their time to be dedicated to producing high-quality academic work over ensuring adequate rest, so the work could be used down the line to secure jobs and research opportunities.

“… Putting projects and stuff on the portfolio… it's like “the Romis” or “Vex,” and it's not that impressive, you know? Plus… If it's not good, you don’t want to show that to people. So, at least for me, wasn't that big, but… It'd be nice to have something cool.” (Senior 1, male)

Discussion

The purpose of this study was to gain a better understanding of this STEM university’s RBE student experiences with rest and work-life balance. Using a thematic content analysis, there were five themes identified that combined to impact these experiences: (i) division of task appraisal; (ii) social dynamics and perceptions; (iii) fluctuating and challenging curriculum, (iv) variations in support; and (v) before and beyond the degree.

As a collective, the integration of these themes was expressed in participant experiences through the presentation and handling of the curriculum determining if it would be a demanding academic situation, how much time would need to be spent on these academic situations being determined by the social factors, resources and support, and motivators interacting with it, and the combination of regularly having demanding academic situations where these factors would lead them to feel stuck in academics. But, as academic matters are separate from life matters, and also cannot overlap with rest, this demand puts a strain on how much time would be available for life and restful activities, with the stress of academics from this combination limiting how much of this time could be used effectively.

Based on participant responses, students in this STEM university’s RBE program feel as though they get less rest than their peers, and that there are many factors of the RBE curriculum which lead to these perceptions of less rest. As predicted, curriculum structuring was found to impact student rest and work-life balance, playing an important role in how much time would be needed for academic work and limiting time for rest when flaws in structuring arose, reflecting what was found in past research on the topic (Cat-Admin, 2020, Beddoes & Danowitz, 2021). By contrast, while the risk of academic failure did create pressure for students to spend less time on
rest and more time on academics within the experiences shared, our predictions were contradicted on where academic failure would be perceived as a threat - participants identified the major threats of academic failure being a threat to social standing (team dynamics, need to be externally perceived as a desirable applicant, sense of belonging within the RBE student culture) and threat to self-perception (identity as an engineer, student, person), whereas threat to financial situation was not discussed, and threat to GPA was only discussed through personal grades, which was viewed as less impactful in comparison. Given not only the positive impact of rest on health and wellbeing, (Centers for Disease Control and Prevention, 2019), but also its positive impacts on student learning through increased memory retention (Quentin et al., 2021, Ritter & Dijksterhuis, 2014, Wamsley, 2019, Martini et al., 2018), this perceived lack of rest and skewed work-life balance among RBE majors is concerning.

The results strongly imply that the areas of difficulty with student experiences on rest and work-life balance in the RBE program that need to be addressed are:

- Within the theme of Division of Task Appraisal: The ability for students to experience rest without the stress of academics; Student behaviors regarding time spent in the labs. Participant comments on non-productive rest presenting as idleness, and rest as a whole being exclusive from working, are perspectives reflected by prior research, but also discussed this a misunderstanding of rest, making this another area of difficulty within these experiences (Immordino-Yang, 2012).

- Within the theme of Fluctuating and Challenging Curriculum: When, how, and why changes made in the duration of the classroom happen; The design and delivery of course and workload goals; Expectations on planning class structure and workload.

- Within the theme of Social Dynamics and Perceptions: The lab culture revolving attitudes on rest and extended work sessions; The effects of team dynamics.

- Within the theme of Variations in Support: The interactions between the work and goals of the labs and lectures in a course; The role of TAs/SAs within RBE courses, both expected and actual; How background knowledge is being scaffolded for student learning, both within the duration of a RBE class, and through prerequisites and the expected progression of the degree
Within the theme of Before and Beyond the degree: The accuracy of advertisements for the RBE program; What graduates of the program should be able to include in their resumes due to their degree.

The present study represents a first attempt to address these issues. We feel that further research examining a larger and more inclusive quantity of experiences may shed light on an expanded range of factors that affect these experiences, alongside further unearthing the full depth of the results found in this study. Future research should aim to involve larger samples of the RBE population, limit the impact of variables such as participant availability and changes through the academic year, and collect more quantitative data alongside expanding the qualitative data. The choice of performing focus groups as the method for this survey led to successfully identifying areas of focus for assessing rest and work-life balance within the universities RBE program, and these themes can be expanded on and explored using a larger range of methods that can overcome the limitations of focus groups (Gibbs, 1997), such as surveys to understand the larger population’s experiences and observations or experiments to identify how these themes are realized in practice to create the experiences shared.

The data does provide suggestions on potential intervention implications in answering our question on what changes participants believed would help to manage work-life balance in the future. Suggestions generated, primarily when prompted by the question of “What small-scale changes would you suggest? Large-scale?” included:

**Participant Suggestion 1: Bridging the gap between lab and lecture**

Participants expressed frustration with the disconnect between lab and lecture content, and suggested a potential need to separate lectures and labs into separate courses, where examples of lecture-oriented and lab-oriented STEM courses can be found in existing literature (Hoffbeck, 2014, Yilmaz et al., 2012).

**Participant Suggestion 2: Supporting TAs/SAs**

TAs/SAs were seen as the backbone of the RBE curriculum, and champions of its success, being praised universally through the focus groups. Participants suggested hiring of more TAs/SAs and increasing their pay, and dedicating some to lecture-specific content could be useful.
Participant Suggestion 3: Native learning

Participants across both focus groups expressed a desire for more opportunities to learn skills natively within the RBE program, expressing that many skills learned in non-major classrooms can be applied to robotics, but felt only tangentially related. Examples of topics being taught natively within RBE were seen as positive experiences by the participants. This was furthered with how learning natively would allow for more targeted skill development, pointing out potential benefits that are supported by literature on how this could allow for expanding education on real-world scenarios unique to the area of robotics that they may see in their careers (Lewin, 2019, Moe, 1977), with the potential of relieving burdens of extra work from new material and breaking the context of old material alike (Soares & Alves, 2021).

In addition to the directions for future research already mentioned, it would be useful to extend the current findings through:

- Exploring the experiences with rest and work-life balance of students in other majors alongside RBE majors, and alongside examining their experiences in this area, comparing and contrasting how those experiences differ with those of RBE students. We encourage exploring and comparing the experiences of students when taking classes native to their major, and when taking RBE classes specifically, regardless of their major.
- Exploring the perspectives and experiences of alumni, as they can provide insight in the long-term effects of the program, and may have suggestions on what RBE skills are beneficial after graduation.
- Exploring the perspectives and experiences of faculty members, as RBE faculty members can provide experiences from teaching these classrooms and perspectives forward progress, and non-RBE faculty members can provide insight on experiences with RBE students in their classes and outside perspectives on the RBE program. This may also expand into exploring the RBE faculty members own experiences with rest and work-life balance, as related themes can be found in literature discussing the work-life balance of academics in these positions, so finding where these experiences stem from may require more in-depth investigations to develop effective enhancements (Bartlett et al., 2021).
- Exploring the perspectives of employers hiring students from the studied RBE program, as they can share what skills they are expecting from graduates, and what benefits these students have on a resume.
Experimenting with what strategies could benefit students with rest, work-life balance, and long-term learning. This may involve exploring what strategies are currently being implemented and their effectiveness.

Although the generality of the current results must be established by future research, the present study has provided clear support for students within the university’s RBE program having experiences with rest and work-life balance that are unique to being undergraduate students of this university’s academic program. Not only was the origin of the expectations and motivators set by the Before and Beyond the Degree theme that affected these experiences distinct to this university, but furthermore, the universal agreement in participants when asked on if they get less rest during RBE classes than their peers, participants reporting experiences and issues with aspects unique to the structuring of RBE classes, and topics on a future in the RBE career being identified as a stressor that affected these experiences all support these results being exclusive to the RBE program within the studied university. The evidence found within this study can in turn support future research that aims to deepen the understanding of the relationship between these unique experiences and variables that are exclusive to this program that cause this, such that variables that support positive experiences within the program can be implemented, enhancing the quality of the education and student experience within the university's RBE program.

**Conclusion**

From investigating the experiences of students in RBE courses with rest and work-life balance, five themes were identified over two focus group sessions: (i) division of task appraisal; (ii) social dynamics and perceptions; (iii) fluctuating and challenging curriculum, (iv) variations in support; and (v) before and beyond the degree. Alongside negative experiences in these areas, the following were identified by participants as changes they felt would make a positive change: (i) Bridging the gap between lab and lecture, (ii) supporting TAs/SAs, and (iii) native learning. As a preliminary investigation into the experiences of a private STEM institution’s RBE undergraduates, these results come with many limitations, but set the stage for future research and program enhancements alike.
References


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https://doi.org/10.2478/zireb-2021-0021


https://doi.org/10.18260/1-2--20877
Appendix A. Focus Group Sign-Up Survey

General Questions and Contact Information

The RBE Curriculum Enhancement project is looking to run focus groups related to RBE students and their experiences.

If you are interested in joining one of the focus groups, please take this quick survey. Students who are selected to participate will be contacted by a member of the study team afterwards. The focus groups will last for one hour. Students who are selected to participate and take part in the focus group will receive a $20 gift card. Food and drink will be made available as well.

Name

________________________________________________________________

Student Email Address

________________________________________________________________

Which year are you in?

☐ 1st Year (Freshman) (1)

☐ 2nd Year (Sophomore) (2)

☐ 3rd Year (Junior) (3)

☐ 4th Year (Senior) (4)

☐ 5+ Year (5)

What is your expected graduation year?

(Commonly: 2023 for Seniors, 2024 for Juniors, 2025 for Sophomores, 2026 for Freshmen)
Time Availability

Please select the times you are available to meet for the focus groups. Each focus group will be an hour long. Selecting times does not guarantee you a slot in a focus group, but we will be working to accommodate as many people’s schedules as possible.

Choose Available Starting Times for the Week of March 20th-24th

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Choose Available Starting Times for the Week of March 27th-31st
We will be providing participants with food during these focus groups.
If you have any food allergies, please list them below, and we will follow up with you if you are selected to participate.

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Optional Demographics

We hope to collect some basic demographic data as part of our report. Any data collected will be anonymous, and only data for the resulting participants in the focus groups will be used. Providing this information is optional but encouraged.

Age

___________________________________________________________________________

Gender

- Male (1)
- Female (2)
- Non-binary / third gender (3)
- Prefer not to say (4)

Ethnicity

- White (1)
- Black or African American (2)
- American Indian or Alaska Native (3)
- Asian (4)
- Native Hawaiian or Pacific Islander (5)
- Other (6)
### RBE Classes Taken

(*NR counts as completed*)

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Please list any other RBE classes taken (such as 3000s and 4000s)

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Appendix B. Focus Group Interview Guide

Planned Questions

1. What do you consider to be rest?
2. What activities do you consider as productive? Unproductive?

At this point, the following definition of rest was provided: For the remaining questions, we are going to define rest as ‘Rest is any activity which rejuvenates the mind or body,’ and encourage you to keep this in mind when answering these questions

3. How regularly do you engage in rest? (Note. This was answered through a raise of hands)
4. What types of rest do you do?

At this point, participants were encouraged to think about their experiences when taking RBE classes.

5. When taking RBE classes, do you feel like you spend more or less time on rest than your peers in other majors?
6. Are you able to balance RBE work and rest?
   6.1. Those who can't, what barriers are there, and those who can, how do you do so?
7. Do you have experiences with professors doing something helpful towards your experiences with rest that stood out to you? TAs, SAs, and Lab Managers?
   7.1. Share your experiences
8. What small-scale changes would you suggest? Large-scale?

Additional Questions Prompted by Discussion

During the Senior Focus Group:

9. How has being an RBE major and taking RBE classes affected your perception towards robotics in general?