education sciences

MDPI

Article

Exploring Students' Experiences with Mindfulness Meditations in a First-Year General Engineering Course

Larkin Martini, Mark Vincent Huerta *, Jazmin Jurkiewicz, Brian Chan and Diana Bairaktarova

Department of Engineering Education, Virginia Tech, Blacksburg, VA 24061, USA; lmmartini@vt.edu (L.M.); jurkiewicz19@vt.edu (J.J.); brianchan1@vt.edu (B.C.); dibairak@vt.edu (D.B.)
* Correspondence: markhuerta@vt.edu

Abstract: With growing mental health concerns among college students, they need to effectively develop skills to alleviate stress amidst the demands of university life. Teaching mindfulness skills to engineering students early in their programs, such as during introductory courses, may provide students with the tools they need to effectively cope with academic stressors, support well-being, and mitigate mental health concerns. This study aimed to understand the variation in experiences of engineering students who participated in weekly mindfulness meditation during a first-year cornerstone engineering course. This study used a thematic analysis approach to analyze students' in-class, weekly reflections from eight meditation exercises across two course sections. The frequency of codes and themes were then analyzed across meditation types to identify trends in student experiences. Our results show that the most common student experience from engaging in mindfulness meditation was feeling less stressed, calmer, and more relaxed. Other positive experiences include feeling more energized and focused. Some students, however, did report some negative experiences, such as distress and tiredness. The Dynamic Breathing exercise, in particular, showed higher rates of negative experiences than other meditation types. The results also demonstrate that different types of meditations produce different student experiences. Meditation exercises with open monitoring components showed higher rates of insight/awareness and difficulty focusing attention than focused attention meditations. These findings indicate that utilizing weekly mindfulness exercises in introductory engineering courses can benefit students' overall mental health and well-being when adequately implemented.

Keywords: mindfulness; mental health; engineering education; first-year engineering course

Citation: Martini, L.; Huerta, M.V.; Jurkiewicz, J.; Chan, B.; Bairaktarova, D. Exploring Students' Experiences with Mindfulness Meditations in a First-Year General Engineering Course. *Educ. Sci.* **2024**, *14*, 584. https://doi.org/10.3390/educsci14060584

Academic Editor: Chiara Buizza

Received: 19 April 2024
Revised: 13 May 2024
Accepted: 24 May 2024
Published: 29 May 2024

1. Introduction

The escalating mental health issues among students in higher education have become a significant concern. Recent research, including a large-scale survey involving over 30,000 undergraduates, has highlighted a disturbing increase in mental health disorders [1]. This survey reported that 35% of undergraduates exhibited symptoms of major depressive disorder, and 39% showed signs of generalized anxiety disorder, figures that starkly surpass those of previous years. The impact is disproportionately higher among specific demographics, including low-income students, students of color, women, and non-binary students, indicating a deeper underlying issue in the academic environment. The severity of this situation is underscored by the fact that suicide was already the second leading cause of death among college students [2]. Furthermore, the demand for mental health services has dramatically increased, as evidenced by Lipson et al. [3] who noted a rise in service utilization from 19% to 34% between 2007 and 2017, paralleled by an increase in depression and suicidality among students.

In engineering education, a similar distressing trend is observed, often attributed to what has been termed an "engineering stress culture". A notable study by Jensen and Cross [4] involving over 1000 engineering students found significant levels of stress, anxiety,

and depression, with female and first-generation students mainly affected. This study highlighted that stress and mental health challenges in engineering are higher than those in a non-clinical sample of U.S. adults, underscoring the unique pressures faced by engineering students. The academic rigor and heavy workload inherent in engineering programs cultivate a culture of stress and hardship, as Godfrey and Parker [5] discussed. This environment elevates stress levels and impacts students' sense of belonging and persistence in the field. Previous research, such as that of Marra et al. [6], has identified a lack of belonging as a primary reason for students leaving engineering programs. Furthermore, Lipson et al. [7] found that engineering students, despite apparent mental health problems, are less likely to seek help compared to their peers in other disciplines. This reluctance highlights the critical need for embedding mental health education and support within the engineering curriculum.

Amidst these challenges, mindfulness meditation has gained recognition as a viable tool for enhancing students' mental health and well-being. Studies like Huerta et al. [8] have begun to explore the application of mindfulness in engineering education, showing promising results in stress management and improved focus. Furthermore, implementing mindfulness practices has been seen by students as a demonstration of instructor care for their well-being [9]. However, the literature on the efficacy of mindfulness meditation in engineering education, particularly in in-person classroom settings, is still in its nascent stages, calling for more comprehensive research.

This study aims to fill this gap by evaluating the impact of weekly mindfulness meditation sessions in an engineering program's first-year, project-based learning (PBL) course. Targeting first-year students who are navigating the critical transition from high school to college, this study investigates their experiences with mindfulness meditation. Given the well-documented declines in psychological well-being and increases in distress among first-year college students [10] and the rigorous nature of first-year engineering curricula, this research is timely and relevant. The choice of integrating mindfulness meditation in a PBL course for this study aligns with the active learning pedagogies used in the course and the potential of mindfulness practices to enhance attention [11] and interpersonal skills [8] which are crucial in these learning environments. Our primary research questions are as follows:

1. What are the experiences of first-year engineering students with weekly mindfulness meditations in a general engineering course?
2. How does the type of meditation affect students' experiences?

2. Background

2.1. What Is Mindfulness?

Mindfulness, deeply embedded in Buddhist philosophy, was introduced to the Western world in a secular context in the early 1980s. Its roots can be traced back to the Buddhist term 'sati', which conveys meanings such as "intentness of mind", "wakefulness", and "lucidity" [12]. Western researchers' secular adaptation of mindfulness, notably from the early 1980s onwards, has catalyzed its widespread acceptance and study. This is evident in the exponential growth of mindfulness research, with a surge from less than ten publications per year before 2000 to over 1000 yearly publications in recent years (2019–2023), as per the American Mindfulness Research Association Library. The association of mindfulness practices with various mental and physical health benefits has played a pivotal role in its rising popularity in scientific circles and mainstream media.

In this study, we use Kabat-Zinn's [13] definition of mindfulness as "paying attention in a particular way, on purpose, in the present moment, and non-judgmentally". Mindfulness meditation, emerging from this broader concept of mindfulness, is a practice where individuals learn to focus their attention and cultivate an attitude of acceptance. This practice involves techniques like focused attention meditation, where the individual learns to maintain attention on an object (e.g., breath) and gently redirect focus when distractions occur, non-judgmentally [14]. The cultivation of mindfulness through regular meditation

has been well-established in recent research [15]. Mindfulness can manifest as either a trait or a state. Trait mindfulness refers to an individual's overall or dispositional level of mindfulness over a prolonged period, while state mindfulness is more immediate and transient. Meditation can immediately affect state mindfulness, but influencing trait mindfulness requires more regular and sustained practice.

2.2. Overview of Mindfulness-Based Interventions (MBIs) among College Students

Mindfulness-Based Interventions (MBIs) have demonstrated their effectiveness in various domains, particularly in academic settings. The success of programs like Mindfulness-Based Stress Reduction (MBSR) has led to adaptations for specific populations, including university students. Systematic reviews and meta-analyses have consistently shown the effectiveness of MBIs in improving mental health and well-being among college students [16–18]. Mindfulness-Based Interventions (MBIs) are relevant in university settings due to students' unique challenges. University students represent a vulnerable population as they navigate a critical developmental period, often marked by increased responsibilities and transitional stressors. Research indicates that the median age of onset for many mental disorders falls between the late teens and early twenties [19]. Therefore, university students are a key demographic for interventions to develop productive stress-coping skills.

A comprehensive systematic review and meta-analysis by Dawson et al. [18], which included 51 studies, sheds light on the effectiveness of MBIs in this context. This research found that MBIs lead to improvements in distress, anxiety, depression, well-being, rumination, and mindfulness, with small to moderate effect sizes. Notably, the duration of these interventions, ranging from as brief as 10 min to as long as 27.5 h, did not significantly influence post-intervention stress levels. This finding suggests the adaptability and potential of MBIs in university settings, regardless of their length. In addition, a narrative review by Bamber and Schneider [16] further supports the efficacy of mindfulness meditation in reducing stress and anxiety among college students. Their analysis of 40 studies focusing on anxiety revealed that 33 found significant decreases in anxiety levels. Similarly, 25 out of 34 studies measuring stress noted substantial reductions. These results are consistent with the findings of Bamber and Schneider [17], who qualitatively examined college students' experiences with MBIs across 18 different studies. While most students reported benefits, such as improved awareness, emotional regulation, focus, compassion, and enhanced relationships, challenges were also noted, including feelings of ambivalence and increased anxiety.

Together, these studies underscore the potential of MBIs to impact university students' mental health and well-being positively. They also highlight the importance of tailoring these interventions to meet students' diverse needs and experiences, acknowledging that, while the majority may benefit, individual responses can vary. It should also be noted that unpleasant experiences with meditation can be expected for many participants [18,19].

One study, which included a sample of undergraduate and postgraduate students participating in an 8-week mindfulness program, found that about two-thirds of participants reported unpleasant experiences. However, most participants (85–92%) rated these experiences as not at all or somewhat upsetting [18]. These were usually transient, manageable experiences, such as being aware of unpleasant emotions or thoughts, experiencing sleepiness, or having certain feelings about practicing meditation [18]. Some unpleasant experiences even lead to an important takeaway or benefit the participant. In rare cases, lasting adverse effects have been reported from meditation practice. These findings suggest that instructors should be aware of potential adverse effects and be careful in managing expectations about the benefits of mindfulness practice.

2.3. Overview of Mindfulness-Based Interventions (MBIs) among Engineering Students

Recent studies in engineering education have been exploring the potential of Mindfulness-Based Interventions (MBIs) with promising results. These studies focus on performance enhancement, competency development, and engineering students' mental health and well-

being (MHWB). (redacted for submission) implemented a 4-week mindfulness program for first-year engineering students, finding improvements in intrapersonal competencies, like focus and resilience, and interpersonal skills, such as empathy and teamwork. Dalton and Estrada [20] conducted a study with engineering students participating in a four-session MBI, observing significant changes in trait mindfulness and stress reduction, albeit without a marked effect on intellectual curiosity.

Nolte et al. [21] explored the impact of mindfulness meditations on cognitive stress in first-year engineering students. While the quantitative results showed minimal changes in state mindfulness, qualitative feedback suggested the meditations helped manage stress and improve focus. Other studies complement these findings. Miller and Jensen [9] and Acevedo-Ojeda [11] integrated brief mindfulness meditations into engineering courses, with students reporting benefits, like improved attention, reduced stress, and a sense of instructor care. Bernárdez et al. [22] found that mindfulness training led to better conceptual modeling and productivity in software engineering students.

In parallel with this study, we collected data using the same population and intervention outlined in this study but used a mixed methods approach involving pre–post survey data to assess the impact and explore students' perceptions of the meditations [23]. Interestingly, the quantitative results indicate no significant improvements in mindfulness and resilience; however, the post-survey qualitative results suggest that most students value participating in meditations, especially in reducing stress and enhancing focus. This study found that most students (~60%) thought meditation practices should be integrated into engineering courses to some extent, while only approximately 13% were opposed. Their findings also indicate that approximately 70% of students practice meditation formally or informally on their own, demonstrating meditation's influence on students outside of the classroom.

Collectively, these studies indicate a burgeoning interest in recent years among engineering education researchers in exploring the value of mindfulness in supporting engineering students. However, the existing research has focused on online courses or extracurricular programs, often involving self-selected student samples. This highlights a gap in understanding the impact of mindfulness practices within standard, in-person engineering curriculums. Building upon prior work, our study aims to classify the commonality of student experiences engaging in mindfulness meditations within an in-person engineering course. By focusing on the diverse experiences of first-year engineering students with weekly mindfulness meditations in a project-based learning (PBL) course, this research contributes new insights into how mindfulness can be effectively implemented in standard engineering curricula and its varying impacts on a broader student population. This approach contributes to the growing body of research on mindfulness in engineering education and offers practical implications for instructors considering including mindfulness practices in their teaching methodologies.

2.4. Koru Mindfulness Program

The meditations used were derived from the Koru mindfulness program, which is designed to teach mindfulness, meditation, and stress management to college students and other young adults. There are different definitions and age range inclusions for young adulthood. One such categorization of young adults refers to those between the ages of 18 and 25, which involves a developmental period with key developmental tasks that allow the young adult to participate in self-exploration and identity formation [24]. One study evaluated the effectiveness of the Koru program in a randomized control trial featuring 90 students (66% female and 71% graduate students) and found that students in the experimental group exhibited statistically significant improvements in mindfulness, perceived stress, sleep programs, and self-compassion. In contrast, the waitlist group did not show statistically significant improvements. For our study, a mindfulness program tailored to young adults was an apt fit for our study population, featuring first-year engineering students, typically 18–19 years old.

3. Theoretical Frameworks

Monitoring and Acceptance Theory (MAT)

MAT proposes two primary mechanisms influencing the effects of mindfulness training: attention monitoring and acceptance. These mechanisms align closely with widely used operational definitions of mindfulness and are the primary skills mindfulness training programs seek to develop e.g., [25–27].

Attention monitoring refers to the "ongoing awareness of present-moment sensory and perceptual experiences (e.g., sounds in the environment, specific body sensations, mental dialogue, and images)" [14]. Specific mindfulness meditations support attention training through two primary ways: focused attention (FA) and open monitoring (OM) [28]. FA meditations encourage the meditator to focus on a chosen object and redirect their attention back to the object of focus. For example, a guided meditation may encourage the meditator to notice when their mind wanders and reorient their attention to the focus object, usually the breath. OM meditations involve non-reactive monitoring of the content of experience from moment to moment. For example, a guided meditation may encourage the meditator to observe their thoughts, feelings, or bodily sensations over an extended period without reacting or judging them. OM meditations are considered more challenging because the meditator does not have a focus object to return to if they begin mind wandering with limited attention monitoring. These two meditations can improve attention monitoring, enhance awareness of the present-moment experience, and allow positive stimuli to be noticed more frequently and intensely. However, they can also increase attention to distressing stimuli and intensify negative affect states [14]. Hence, MAT postulates the need to develop acceptance skills concurrently with attention monitoring in mindfulness training programs.

Acceptance is "a mental attitude of nonjudgmental openness and receptivity, and equanimity toward internal and external experiences" [14]. An orientation of acceptance towards experiences allows a person to welcome even negative, distressing thoughts and feelings and allow them to pass as new experiences enter awareness [29]. This contrasts with experiential avoidance or clinging onto these negative stimuli. Accepting experiences openly influences the trajectory of emotional experiences, reducing emotional reactivity [29]. With long-term practice, acceptance can become the default response, requiring less effort to regulate difficult emotions. Guided mindfulness meditation practices typically encourage the meditator to adopt an attitude of acceptance or other attitudes that promote acceptance (e.g., non-judgment, openness, curiosity, etc.) as a lens to noticing and processing present moment experiences while they engage in an attention-monitoring practice. For example, in guided meditations, the facilitator may foster acceptance by encouraging participants to approach their thoughts and feelings with openness and curiosity rather than judging, suppressing, or pushing them away.

MAT thus posits a synergistic relationship between attention monitoring and acceptance skills that drive the effects of mindfulness training, such as stress reduction, improvements in affective states, and executive attentional ability. It is important to note that evidence suggests that acceptance skills may take longer to cultivate while attention-monitoring skills begin to improve immediately after meditation practice [30]. Thus, MAT explains why, in the early stages of a mindfulness training program, some people may experience emotional agitation and an exacerbation of distress because it is likely that attention monitoring is being practiced, and acceptance skills have not yet been developed enough to reduce emotional reactivity.

4. Positionality

The authors of this work have varying levels of experience, relevant knowledge, and connection with mindfulness meditation practices; however, collectively, we believe these are helpful practices that can support one's MHWB, which explains the impetus of the study and why we sought to bring these practices into engineering classrooms and evaluate their utility. As discussed, two of the researchers immersed themselves in mindfulness practices

and teacher training to be prepared to instruct students on mindfulness and facilitate in-person mediation effectively. We acknowledge that we, the researchers, are instruments in interpreting qualitative student responses and their perceptions of the meditations. To mitigate potential biases, the researchers who trained in mindfulness, designed the study and MBI, and implemented the meditations did not participate in the qualitative data analysis. We were also purposeful in conducting a robust inter-rater reliability process to confirm that multiple researchers were interpreting the data in the same way. This process promoted a more objective analysis of the qualitative student responses. As seen in the findings, we are transparent about describing the neutral and negative student perceptions and experiences in addition to the positive feedback.

5. Methods

This study used a pragmatic qualitative approach, starting with a thematic analysis of reflection data followed by quantification of the qualitative data to report the frequency of experiences across meditation types. The quantification of qualitative data can help identify patterns within the data and recognize singularities. These patterns must be continually evaluated against the data and modified to factor in any changes to initial conceptualizations of the data. Qualitative analysis of the data determines connections between patterns and categories [31]. The mixed-methods approach of this study uses Braun and Clarke's [32] thematic analysis to identify the codes and themes that form the categories to be quantified. The iterative process of thematic analysis was used to ensure that categories accurately reflect the data before patterns were evaluated quantitatively.

5.1. Participants and Context

A total of 105 participants from two sections of the same course taught by two different instructors in the first-year engineering program received the mindfulness intervention and consented to be part of the study. The study participants' demographics appear to reflect the institution's College of Engineering demographics. Typically, over 95% of the first-year student cohorts in the College of Engineering are recent high school graduates who are 18 years old. Racial and ethnic characteristics of the sample included Asian (18), Black or African (10), American Hispanic or Latino (6), White (61), and bi-racial (9) students. One student preferred not to say. There were 80 males 23 females, no gender non-binary, and two who preferred not to say. All participants were intended engineering majors at the time of this study.

Participants in this study were students enrolled in the second half of the required two-course sequence in the first-year engineering program in the College of Engineering. These project-based courses introduced students to the diverse engineering profession through data analysis, problem-solving, software tools and modeling, engineering designs, and the development of professionalism in engineering. The university was an R1 research-intensive institution located in the United States's mid-Atlantic region with a large enrollment of first-year engineering students and is known for its engineering programs. During the semester when the study was conducted, there were 27 sections of the same course, each with about 70 students.

5.2. Mindfulness Intervention Design

The mindfulness training used in our study provided an introductory 15-min overview of mindfulness and how it can support students in developing focus and attention, managing stress, and developing other intrapersonal and interpersonal competencies (i.e., self-regulation, empathy, conflict management) that can support engineering work. After this overview session, students were introduced to different types of brief (5–10 min) guided meditations adapted from the Koru Mindfulness training program [33] once per week over a semester. Each student participated in nine mindfulness exercises in total. Eight mindfulness exercises were completed by both course sections, with one additional exercise completed by each course section. These included mindful breathing, diaphrag-

matic (deep) breathing, dynamic (quick) breathing, body scan, guided imagery, labeling thoughts/feelings, gatha, etc. Both instructors had completed Koru Mindfulness Teacher Training workshops before the study intervention and were equipped to facilitate the abovementioned meditations. However, we emphasize that the Koru program influenced the mindfulness training in our study but did not follow the Koru Mindfulness program-specific curriculum. Both instructors alternated facilitating the meditations within both classes to minimize potential bias.

All of the adapted Koru meditations used in this study align well with MAT and involve focused attention (typically on the breath); however, several of the mediations also encouraged open-monitoring of body sensations (i.e., body scan), senses (i.e., guided imagery), thoughts (i.e., labeling thoughts), and feelings (i.e., labeling feelings). Table 1 classifies which meditations facilitate open monitoring (OM) and focused attention (FA).

Table 1. List of the eight mindfulness exercises completed by both sections with a description of the exercise, sample instructions, and classification by focused attention (FA) and open monitoring (OM).

Mindfulness Exercise	Description	Sample Instructions *	Type	Length (min)	Guided by Instructor
Belly Breathing	A deeper breathing technique that can serve as a stress management tool to calm the nervous system and lower stress.	"Breath naturally, and just notice whether the hand on your chest or the hand on your belly moves more as you breathe".	FA	7–10	B
Dynamic Breathing	An active, energizing technique that can be used when feeling very tired, but still need to complete a task.	"Start breathing shapely and deeply through your nose, keeping your mouth closed".	FA	5	A
Body Scan	A type of meditation involving scanning or anchoring attention to the body and observing sensations without judgment.	"Begin by bringing your attention to the bottom of your feet. Notice the feeling of your feet resting against the floor."	FA, OM	8–10	B
The Gatha	A meditation poem to link words to the flow of breath to support anchoring attention to the breath.	"I know I am breathing in, I know I am breathing out. I calm my body and my mind. I smile. I dwell in the present moment. I know this is a precious moment".	FA	10	A
Guided Imagery	A relaxation technique that involves using all the senses to visualize events, scenes, or other things that will cause feelings of comfort.	"...I would like you to see yourself in a very special place...it could be a real place..."	FA, OM	10	B
Labeling of Thoughts	A technique used to practice observing and labeling one's own thoughts, letting them go, and returning attention to the breath.	"When you notice your mind has wandered, see if you can just briefly observe the thoughts, without judging them, gently labeling "thinking"".	FA, OM	10	A
Labeling of Feelings	Similar to labeling thoughts practice except involves labeling feelings, letting them go, and returning attention to the breath.	"Notice. Are thoughts arising? Are feelings present? Label and come back to your breath".	FA, OM	10	B
Ocean Breathing	A breathing technique involving constricting the back of the throat to support lengthening each breath cycle to calm the nervous system and relax.	"With each breath in, notice your lungs filling up and expanding".	FA	10	A

* Taken from the Koru Script [33].

The Koru meditation scripts concurrently support the attention monitoring and acceptance mechanisms by reminding the meditator to stay focused on the object of focus and encouraging attitudes of non-judgment and acceptance when mind-wandering or other distractions inevitably occur. For example, a sample script of the Labeling Thoughts meditation includes the following instructions:

> When your mind has wandered, see if you can just briefly observe the thoughts, without judging them, perhaps labeling them as thinking and then gently letting them go by returning your awareness to the sensations of your breath, your anchor to the present moment experience.

The meditations also include sample scripts to introduce each meditation, describe the purpose of each meditation, including potential benefits, and provide preliminary instructions as needed. These introductory scripts also encourage participants to approach the meditation with open-mindedness and curiosity, which align with and support the acceptance component of MAT. An example of this can be found in the Gatha meditation introductory script:

> Now let me warn you that when I first introduce you to the gatha, you may notice yourself feeling skeptical about it. See if you can observe that attitude, remain open-minded, and notice what happens when you practice the gatha.

Overall, the mindfulness meditations introduced to the first-year students align well with promoting attention-monitoring and acceptance as identified in MAT, the essential mechanisms required to cultivate mindfulness, and the associated positive outcomes.

5.3. Qualitative Data Collection

This study uses reflection data collected from 105 students across eight meditation exercises facilitated in both class sections, resulting in 944 reflections. For the reflections, students were asked to respond to the prompt:

> "What did you notice from your meditation today? Record your thoughts, feelings, and other insights".

The prompt remained consistent across all meditation exercises. The design of this prompt intentionally encouraged students to share their thoughts and experiences of the meditations without influencing their reflection in any way. The open-ended nature of the reflection question provided space for students to respond in a manner comfortable and authentic to them.

The reflections were completed as in-class assignments and were required for all students regardless of participation in the study. Participants were given about 3–5 min after each meditation during class to write reflections. Due to the nature of the reflections as assignments, researchers were aware of the possibility of desirability bias. To mitigate this bias, students were instructed that their responses would be graded based on completion to encourage honesty.

At the beginning of the semester, students were introduced to mindfulness and meditation in class. Information about the study was provided, and consent forms were given to decide whether to participate. The appropriate institutional review board approved study procedures and consent forms.

5.4. Qualitative Data Analysis

Data were initially analyzed using a thematic analysis approach, as Braun and Clarke [32] described. First, the authors familiarized themselves with the reflection data and then generated initial codes through inductive coding. Initial themes were then inductively created from the codes and iteratively compared with the reflection data to generate a codebook. After the inductive creation of the initial themes through thematic analysis, mindfulness mechanisms were deductively determined from the MAT framework, and pre-existing classifications of emotional valence/intensity were deduced from the literature

to compare them to the thematic groupings. We determined that our primary themes could be distinguished by emotional valence (e.g., positive, neutral, and negative experiences). We organized the individual codes that describe specific positive and negative experiences along a spectrum of emotional intensity. Neutral experiences were related to the MAT framework mechanisms. Inter-rater reliability was performed to evaluate code clarity and identify areas of confusion through comparative analysis across three coders. The redefined codes were then used during a final pass of the data. Each reflection was assigned between 1 and 5 codes that best reflected the student's response. The reflection analysis was recorded in a spreadsheet for additional analysis.

Though the study is predominantly qualitative, using qualitative data and creating a codebook through an inductive coding approach, the codes were also quantified to investigate trends between meditation types. This analysis used a basic comparison between code frequency across meditation types but did not utilize further statistical analysis methods, as statistical relationships and significance fell outside the scope of this study. Additionally, to analyze for desirability bias, the frequency of codes on a per student basis was evaluated. This test was to see if individual students were reporting the same experiences across all meditation types, as they likely would do if trying to meet teacher expectations, or if they appeared to be reporting different experiences depending on the meditation exercise. This analysis indicated that individual students were reporting a variety of positive and negative experiences, depending on meditation type, which we believe indicates that students felt comfortable providing honest opinions in their reflections.

6. Results

The thematic analysis resulted in 16 codes, 12 related to experiences, and 4 additional codes noting external influences, outside practice, no strong opinion, and notes about classmates. The four additional codes provide context that explains why a student may have a specific experience in response to the meditation exercise outside of the meditation itself. The 12 codes related to student experience were then classified into three overarching themes: positive, neutral, and negative experiences (denoted in tables and figures using shades of blue, gray, and orange, respectively). Energized, insight/awareness, calm/relaxed, focused, and generally positive were classified as positive experiences. Physical observations and attention monitoring were considered neutral. Negative experiences included generally negative tiredness, difficulty focusing, weirdness, and distress. These themes follow the concept of emotional valence, which refers to the extent to which the emotion is positive/pleasant or negative/unpleasant. Valence is often paired with intensity (strength or energy) when describing emotions [34–36]. As seen in Table 2, codes in the codebook are arranged as positive versus negative experiences, with the highest intensity experiences at the top and bottom and the intensity reducing towards the middle until the neutral experiences. Following this energized and distressed are high intensity; insight/awareness and weirdness are medium intensity; calm/relaxed and tired are low intensity. Focus and difficulty focusing also have a neutral intensity; however, unlike insight/awareness and weirdness, both are determined to have a relatively neutral valence—generally neither positive nor negative. Increased focus, however, was determined to lean towards a positive experience, given its specific benefits in the classroom context.

The classifications of weirdness and distress were very similar; however, they were distinguished by the intensity of the emotion. Distress indicated an inability to find usefulness in the meditation and discomfort at an intensity that negatively impacted them physically, mentally, or emotionally. Weirdness indicated that the student found the meditation odd, and perhaps felt some mild discomfort from participation, but this category is distinguished from distress in that the student did not experience discomfort at an intensity that seemed to negatively affect them physically, emotionally, or mentally. Weirdness was often accompanied by beneficial experiences, such as feeling energized,

being willing to use it outside of a group setting or acknowledging that the meditation could benefit others even if it was not for themselves.

Table 2. Codes are determined by thematic analysis with descriptions and example quotations.

Code	Description	Quotation
Energized	An increase in energy, feeling more awake, improved mood, and a sense of joy or happiness.	"The meditation really helped today! I didn't get much sleep last night, and was dozing off earlier today. After that exercise, I felt like a new man. This is definitely coming in handy later while I'm doing hw. I really appreciate these meditation segments".
Insight/Awareness	Notes and realizations about themselves, how they feel or perceive things around them.	"The meditation made me realize how run down I am already beginning to be this semester because it highlighted how tired I really am if I take a break to reflect. Im hoping to be able to give myself more time to decompress and to not always be nonstop going"
Focused	Students indicate an increased ability to focus, pay attention, and/or have clarity after the meditation.	"It was very good! I felt like it opened my mind more and I was able to think clearly during class time today"
Calm/Relaxed	Feeling more grounded, calm, and indicating lower stress.	"The meditation experience was one that definitely helped me calm a lot of my nerves. I've been undergoing a lot of stress recently, balancing a full course load and my extracurriculars as well. Through meditation, I was able to keep my mind off these things and focus on more calming aspects of my daily life, with something as simple as breathing, so it definitely helped".
Generally Positive	A general sense that the meditation was helpful, without any specific reason as to why.	"I felt like a bird that was just freed out of the cage, I liked how we labeled [our] thoughts so we could recognize patterns in meditation, that was very helpful".
Physical Observations	Notes about physical observations, such as muscle tension, breathing, and heart rate.	"I like how as you are working up your body during the scan, I'll hit a muscle group that is tight but its not something I would regularly notice. As I focus its like the tension melts and my muscle gives out on its own in a good way".
Attention Monitoring	Students indicated that their minds wandered, but they could regain focus on meditation or breathing.	"I noticed during the meditation that my thoughts were jumping all over the place. After getting a reminder, I focused on the breathing alone and I believe it was more effective. I felt less on edge and safer sitting in my chair, which made me feel better".
Generally Negative	A general sense that the meditation was unhelpful, without any specific reason as to why.	"I didn't exactly feel any different from before meditation than after meditation".
Tiredness	The meditation left the students feeling sleepy, tired, or more exhausted during or after the meditation than before.	"I noticed I felt really tired after, but that could just be a product of it being a rainy day and warm in the classroom".
Difficulty Focusing	Students could not focus on meditation or discuss thoughts utterly unrelated to the meditation during that time.	"I noticed I couldn't settle down my mind for more than a few minutes. I was thinking about school, my family, this class, the stock market, and little stuff like TV. I have been trying to do a lot recently, trying to learn the ins and outs of the stock market while trying to give a lot of effort in my classes. It is difficult to balance but I am hoping that meditating can help with that and I might start meditating outside of class as well".
Weirdness	Students mention that the meditation felt odd or silly but not to the point of discomfort. This can include a student, still finding benefit from the meditation, but indicating that they did not enjoy doing so in a group setting.	"The meditation today was definitely interesting. I was a little uncomfortable doing it in class, but I definitely felt like I had more energy afterward. I'm interested to try it again".
Distress	Student indicates physical, mental, or emotional discomfort or pain due to the meditation, especially if it prevented the student from participating in the meditation or left them feeling worse after the meditation.	"My chest started to hurt. I feel a little weirder and more air-y. It also made me a little light-headed and made my head pound. I didn't really enjoy it that much to be honest".

6.1. Frequency of Experiences

The quantification of the codes was analyzed to determine the frequency of experiences across meditation types. The frequency of experiences is the percentage of each experience reported by students compared to the total number of experiences reported by students for that meditation exercise. While the analysis reports the results of individual experience codes, many student reflections were coded with multiple codes simultaneously. For example, the following response shows a student experiencing feeling calm/relaxed and having difficulty focusing, with mentions of external influences:

> "The meditation proved to be a relaxing moment amid a very stressful and busy Monday. I noticed my mind drifting to other thoughts and responsibilities during this time, and despite trying to remain centered, I found myself planning out when I will get the rest of my homework done or when I'll find time to get into the gym. With so much going on, it is often difficult to step away and appreciate the moment. However, despite these difficulties, the meditation was relaxing and worthwhile experience".

In this quote, the student notes that the meditation was relaxing but that they had difficulty focusing, as seen in the student planning to finish homework and find time to go to the gym. Some of the external influences mentioned include that Monday was very stressful and busy and that it is difficult to step away with so much going on. Since student reflections could be coded with multiple codes simultaneously, the percentage of each type of experience for each meditation was calculated with the total number of codes coded for each meditation rather than the total number of reflection responses.

Figure 1 graphs the frequency of experiences across meditation types. The figure follows the color scheme from Table 2, with the speckled blue denoting positive experiences, gray with zig-zagged stripes denoting neutral experiences, and orange representing primarily unbeneficial experiences. A table of the percentages has also been provided (Table 3).

Table 3. Table showing percentage values of each code for each meditation exercise, average for each meditation type, and the total average across all meditations.

Code	Diaphragmatic Breathing	Dynamic Breathing	Body Scan	Gatha	Guided Imagery	Labeling Thoughts	Labeling Feelings	Ocean Breathing	Average FA	Average FA/OM	Total Average
Energized	4%	41%	3%	6%	5%	4%	4%	2%	11%	4%	7%
Insight/Awareness	3%	1%	1%	4%	5%	14%	24%	0%	1%	11%	5%
Focused	9%	10%	7%	12%	10%	4%	4%	0%	6%	6%	6%
Calm/Relaxed	44%	5%	45%	41%	49%	32%	26%	56%	29%	38%	30%
Generally Positive	6%	5%	9%	9%	6%	14%	16%	14%	7%	11%	8%
Physical Observations	16%	2%	19%	2%	10%	3%	0%	7%	6%	8%	6%
Attention Monitoring	4%	1%	1%	2%	2%	11%	1%	2%	2%	4%	3%
Generally Negative	2%	4%	3%	4%	5%	1%	8%	6%	3%	4%	3%
Tiredness	8%	2%	11%	10%	4%	6%	5%	4%	5%	7%	5%
Difficulty Focusing	4%	0%	1%	5%	4%	9%	10%	0%	2%	6%	3%
Weirdness	0%	21%	1%	4%	0%	1%	0%	7%	7%	0%	3%
Distress	1%	8%	1%	1%	0%	2%	1%	1%	2%	1%	2%

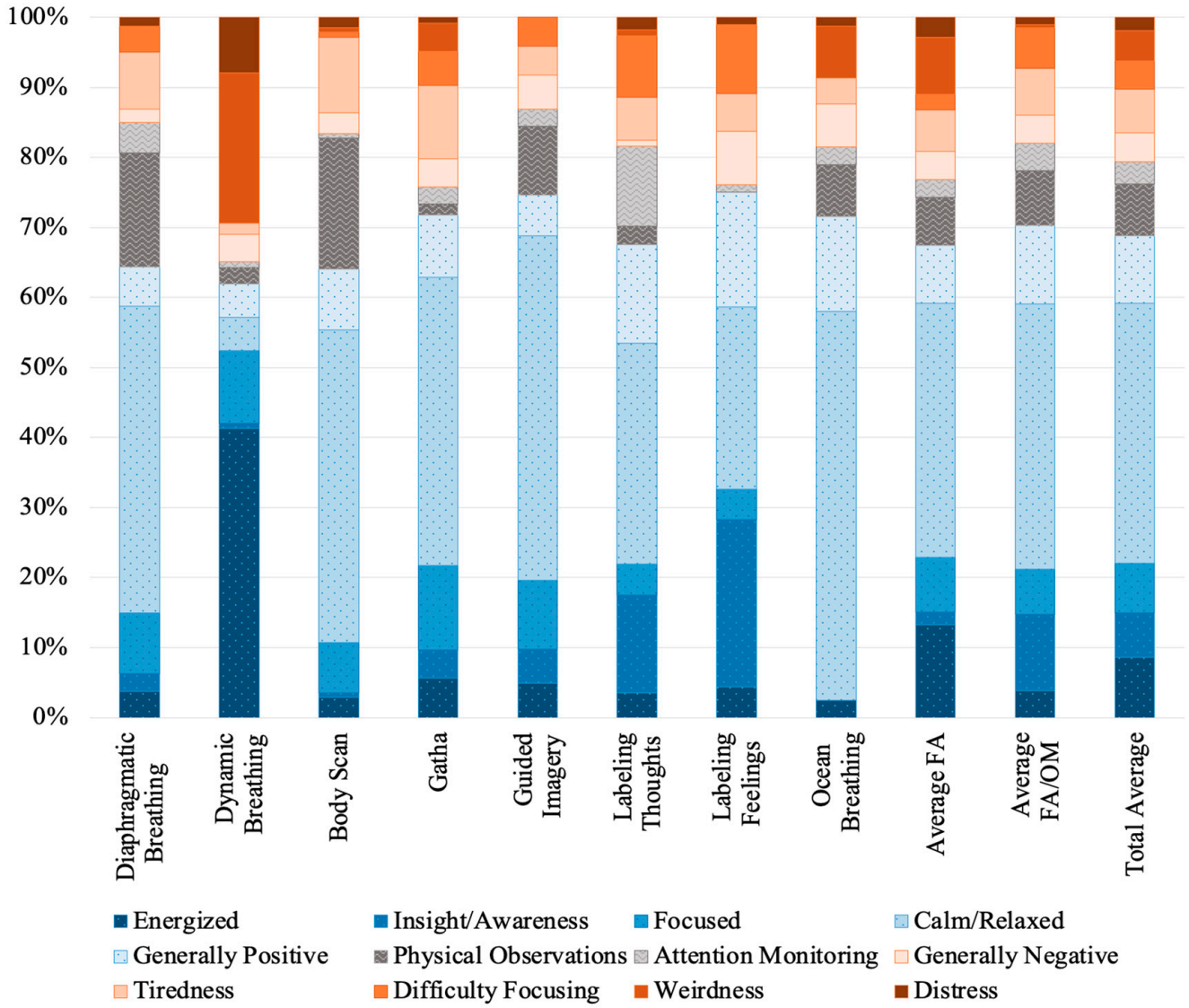

Figure 1. Bar graph showing the frequency of experiences for each meditation exercise, the average for each meditation type, and the total average across all meditations. The meditation types are focused attention (FA), and open-monitoring (OM).

6.2. General Trends

Students reported various experiences across the mindfulness exercises, depending on the type of meditation and external influences. The most frequent result from student participants was a sense of relaxation and reduced stress. Increased feelings of focus were also reported across many of the meditations and were often coupled with feeling relaxed or energized. Fewer students reported negative experiences than positive experiences with the meditation exercises. The most frequent negative experience from participation in the mindfulness exercises was tiredness, often accompanied by the positive experience of feeling calm/relaxed. For example, one student wrote:

> "After the meditation I feel extremely tired but relaxed at the same time. Overall, it felt really good and I enjoyed it".

This quote illustrates how students felt tired and relaxed at the same time but overall had a positive experience with the mindfulness exercise. While some general trends can be seen across all exercises, there is also some notable variation across mediation types.

6.3. Trends across Meditation Types

The focused attention (FA) meditations included diaphragmatic breathing, body scan, gatha, and ocean breathing. The meditations all resulted in higher rates of decreased stress and increased relaxation (41–56%). Out of these meditations, Gatha left students feeling the most focused (12%), followed by Guided Imagery (10%). Meditations that encouraged students to focus their attention on their bodies had increased reports of physical observations, in particular the Diaphragmatic Breathing (16%) and Body Scan (19%).

While all the meditations practiced FA, several also included elements of open-monitoring (OM). In particular, the Labeling Thoughts and Labeling Feelings still predominantly invoked feelings of reduced stress and increased relaxation (32% and 26%, respectively), although at lower rates than the FA meditations. These FA/OM meditations also showed higher rates of insight/awareness (14% and 25%, respectively) and slightly higher rates of difficulty focusing attention without attention monitoring (9% and 10%). A proportion of 11% of students reported practicing attention monitoring and being able to refocus their thoughts on the meditation during the Labeling Thoughts exercise.

The most unique meditation regarding student experiences was the dynamic breathing meditation. Whereas most of the meditations resulted in decreased stress and increased relaxation, the dynamic breathing meditation left many students feeling energized (41%) with very low relaxation rates (5%). This meditation also had the highest reported levels of unbeneficial experiences, with general discomfort and weirdness (21%) and high levels of distress (8%) being reported as higher proportions than other meditations.

6.4. External Influences

In addition to the outcomes, many students mentioned outside influences that affected their meditation experiences. Some of the most commonly mentioned influences included lack of sleep and school-related stressors, such as exams and workloads. In some cases, these influences could make it more challenging for students to focus on the meditation. Still, students also discussed how the meditation could help alleviate some of this stress and provide a moment of peace. One student noted their discomfort with meditating in a large class size or having a mental illness that impacted their comfort level with engagement in meditations. These types of outside influences, in particular, may affect students' desire to engage in classroom meditations. Overall, these examples help demonstrate how outside contexts are just as influential to students' meditation experiences as the type of meditation practice.

7. Discussion

7.1. General Trends

This study was designed to capture the variation in students' in-person experiences engaging in mindfulness exercises in an engineering classroom. Our findings illustrate both the positive and negative experiences that may occur during mindfulness meditations and the frequency with which these experiences occur.

On the positive end of the spectrum, students found the meditations enhanced focus, leading to insights and realization, and could improve mood and energy levels. As shown in Figure 1, our findings indicate that these experiences of improved emotional valence were most common, seen in the higher rate of positive experiences compared to negative ones. These findings align with previous research that has found mindfulness meditation to be associated with lowering the intensity and frequency of negative affect and improving positive mood states [16–18]. The most commonly reported student experience in our study was feeling more calm or relaxed and less stressed. This finding is also consistent with previous research that has studied the effects of MBIs on college students [16] and with engineering students specifically [8,37,38]. These findings indicate that, when applied to a classroom environment, stress reduction can be beneficial for most students. Providing students with a wide range of mindfulness practices could also be helpful for stress man-

agement outside the classroom. First-year courses, such as the introductory engineering course, provide students with these skills early in their program.

On the negative end of the spectrum, students reported feeling more tired and experiencing various levels of discomfort due to their participation in meditations. These unpleasant experiences have also been reported and align with prior work [17,20,21]. These findings suggest that positive experiences tend to outweigh negative experiences significantly, but instructors should be aware that students can have distressing experiences in rare cases.

MAT may also explain why certain students did not benefit from the meditations. One possible explanation may be that students engage in varying levels of attention monitoring without having developed their acceptance skills sufficiently to reduce emotional reactivity. According to MAT, attention monitoring without acceptance may heighten affective experience and reactivity and thus could exacerbate a negative experience [14]. Several students described difficulties in focusing on the meditation (i.e., mind wandering) and struggled to engage in attention monitoring continuously. Student descriptions of mind wandering were typically associated with more negative experiences with the meditation, which is an indicator that some students struggled with practicing both attention monitoring and acceptance. It is important to note that not all students will benefit immediately from in-class meditations, and it may take some students additional time and practice to cultivate both attention monitoring and acceptance skills. However, introducing students to these skills in a classroom setting may provide them with a foundation for further development of these stress management skills.

7.2. Trends across Meditation Types

The study findings also demonstrate variation in student experiences between different types of meditations. For example, while reduced stress and increased relaxation are still present across almost all the meditations, the two FA/OM meditations with an emphasis on metacognitive monitoring (i.e., Labeling Thoughts and Labeling Feelings) evoked higher rates of insight, but more students describe difficulties in monitoring their attention. This is not a surprising finding, as open monitoring is considered a more advanced skill typically introduced later in MBIs once participants have had practice with FA meditations [28]. The most unique meditation was the dynamic breathing meditation, as this was the only FA meditation that utilized movement and, consequently, was the only meditation that led to increased emotional intensity. While many students report positive, energizing effects of this meditation, this meditation also led to higher levels of discomfort. It may be less practical to use in large-class settings. Therefore, this meditation may be less effective for stress management. Overall, however, there was a similar breakdown in commonality of experiences with the other meditations, as seen in Figure 1 and Table 3.

7.3. Recommendations for Engineering Instructional Faculty

Instructors interested in integrating mindfulness meditations in their classes should familiarize themselves with some of the basics of mindfulness theory to effectively describe to students the purpose of integrating meditations in their classes. There is an abundance of recorded meditations, meditation scripts, apps (e.g., Calm, Headspace, etc.), and other resources available that instructors can use to facilitate meditation during class. Instructors should be intentional about which meditations they use, including the duration and timing of their course.

In our study, we opted to use a variety of brief (5–10 min) weekly to bi-weekly meditations introduced at the beginning of class to help students settle in, relax, and support focus. For instructions intending to include occasional meditations, we recommend using FA meditations and integrating them during heavy exam/work weeks or classes involving particularly challenging or stress-inducing content to help students manage stress and emotional reactivity, as well as support focus. For instructors who intend to include meditations regularly, we recommend starting with FA meditations and introducing

blended FA/OM meditations over time once students have a foundation for practicing attention-monitoring and acceptance in a more structured approach. In all cases, recorded meditations or scripts should emphasize and encourage the practice of attention monitoring and acceptance concurrently during meditations. Examples of how meditations incorporate these two mechanisms can be seen in the Methods section.

Finally, we also want instructors to know that it is common for meditations to lead to unpleasant student experiences. We recommend that instructors convey to students that this is a normal and that these are usually transient, manageable experiences. However, in some cases, especially if a student remembers a difficult or traumatic event, discontinuing the meditation may be best. Instructors should stress to students that participation in meditation is encouraged but optional. Caution should be used with all meditation practices, especially those involving any movement, as they can increase student discomfort, especially in large group settings. If instructors decide to use such meditations to help increase the energy of the class, precautions should be taken to help mitigate some of this discomfort, such as facing away from the center of the room, and instructors should emphasize that students are welcome to sit out of the exercise if they are feeling discomfort.

7.4. Limitations and Future Work

The limitations of this study fall into three broad categories—demographics and context, meditation facilitation, and data collection. First, regarding demographics and context, the data for this study was collected from two design courses at a single university. While this may allow for some generalizability of the findings within similar contexts, it limits generalizability in all university contexts, class sizes, or course types. Additionally, this study does not analyze experiences between demographic variables, limiting the analysis of student background and identity regarding their experiences with the exercises. Future studies could be performed at other universities and across different class sizes and types to test the generalizability of the findings. Additionally, these studies could analyze if experiences vary by demographics, such as age, gender, and disability status. Within the context of the courses themselves, the timing of the meditation during the class period—beginning, middle, or end—and during different times in the semester could be explored to determine when best to implement mindfulness exercises and of what types, based on class activities and external events such as exams and breaks.

Second, the instructors guiding the meditation exercises were trained mindfulness facilitators. While this may positively influence student experiences with the meditations, it is unclear whether student experiences would change if an instructor without mindfulness training facilitated the meditations or if recorded meditations were used instead. We acknowledge that not all instructors will have access to formal mindfulness training. Future studies could look at possible differences in using open-source, recorded meditations, which may be more accessible for instructors.

Finally, for this portion of the study, students were asked to complete their reflections immediately after each meditation, which has the benefit of providing accurate, real-time data but limits our ability to capture long-term impacts or how the meditation may have influenced students' class engagement. Additionally, the reflections only provided students a few minutes to describe their experiences after the meditation, limiting the detail of the qualitative responses as the breadth of responses was prioritized over depth. We chose this format to aid in collecting a wider variety of experiences rather than focusing on a few self-selected students. As part of the broader study, students partook in a post-semester survey to report their experiences and opinions of the meditation exercises overall, the findings of which can be found in (redacted for review).To address the limitations in post-exercise reflections, future research could implement additional reflections after the class session to explore how the meditation exercises impact student engagement in class, such as their attention to class instruction and their interactions with peers. Furthermore, such a study could benefit from follow-up interviews or focus groups with students, allowing for a more detailed understanding of student experiences with mindfulness exercises in the classroom.

In such studies, the current study could form a foundation for understanding students' experiences with in-class mindfulness exercises and can inform future interview protocols.

8. Conclusions

This research study aimed to understand better and classify the full range of student experiences with mindfulness meditations integrated into a first-year engineering PBL course. Our findings demonstrate that brief (5–10 min) meditations benefit most engineering students and support their MHWB. By organizing and quantifying the different student experiences, we provide insight into the most common experiences. Our results indicate that the meditations elicit positive shifts in emotional valence and reductions in emotional intensity. The most common outcome of students is feeling more relaxed and less stressed after participating in the meditation. However, we also acknowledge that it is not uncommon for students to have unpleasant experiences and, in some rare cases, even experience distress. We encourage instructional faculty interested in implementing mediations in their classes to familiarize themselves with mindfulness theory and follow our recommendations, as they can help mitigate potential risks and maximize the benefits. While further research is needed to explore the integration of meditations in engineering classrooms, our study suggests that they offer tremendous potential to help combat the ongoing mental health concerns that are plaguing a significant number of engineering students and disproportionately affect underrepresented groups.

Author Contributions: We acknowledge that drafting this manuscript involved a collaborative effort and want to highlight specific contributions made. L.M. led the qualitative data analysis and made substantial contributions to the paper writing. M.V.H. was the principal investigator for the project and led the data collection efforts, provided support to the data analysis, provided substantial contributions to the writing, and led the organization and development of the article. J.J. and B.C. provided support to the qualitative data analysis through inter-rater reliability checks and also made contributions to the paper writing. D.B. was the co-principal investigator for the project and provided support to the data collection and analysis efforts, and made contributions to the paper writing. All authors have read and agreed to the published version of the manuscript.

Funding: The research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of Virginia Tech (protocol code 22-309 and 8/19/22).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data that support the findings of this study are not publicly available due to restrictions imposed by the Family Educational Rights and Privacy Act (FERPA). As the study involves student data, sharing these data publicly would compromise the privacy and confidentiality of the participants. However, aggregated data and additional details about the study methodology are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interests.

References

1. Chirikov, I.; Soria, K.M.; Horgos, B.; Jones-White, D. *Undergraduate and Graduate Students' Mental Health during the COVID-19 Pandemic*; University of California, Berkeley: Berkeley, CA, USA, 2020.
2. Taub, D.J.; Thompson, J. College Student Suicide. *N. Dir. Stud. Serv.* **2013**, *2013*, 5–14. [CrossRef]
3. Lipson, S.K.; Lattie, E.G.; Eisenberg, D. Increased Rates of Mental Health Service Utilization by U.S. College Students: 10-Year Population-Level Trends (2007–2017). *Psychiatr. Serv.* **2019**, *70*, 60–63. [CrossRef]
4. Jensen, K.J.; Cross, K.J. Engineering stress culture: Relationships among mental health, engineering identity, and sense of inclusion. *J. Eng. Educ.* **2021**, *110*, 371–392. [CrossRef]
5. Godfrey, E.; Parker, L. Mapping the Cultural Landscape in Engineering Education. *J. Eng. Educ.* **2010**, *99*, 5–22. [CrossRef]
6. Marra, R.M.; Rodgers, K.A.; Shen, D.; Bogue, B. Leaving Engineering: A Multi-Year Single Institution Study. *J. Eng. Educ.* **2012**, *101*, 6–27. [CrossRef]

7. Lipson, S.K.; Zhou, S.; Wagner, B.; Beck, K.; Eisenberg, D. Major Differences: Variations in Undergraduate and Graduate Student Mental Health and Treatment Utilization Across Academic Disciplines. *J. Coll. Stud. Psychother.* **2016**, *30*, 23–41. [CrossRef]
8. Huerta, M.V.; Carberry, A.R.; Pipe, T.; McKenna, A.F. Inner engineering: Evaluating the utility of mindfulness training to cultivate intrapersonal and interpersonal competencies among first-year engineering students. *J. Eng. Educ.* **2021**, *110*, 636–670. [CrossRef]
9. Miller, I.; Jensen, K. Introduction of Mindfulness in an Online Engineering Core Course during the COVID-19 Pandemic 2020. *Adv. Eng. Educ.* **2020**, *8*, 1–7. Available online: https://advances.asee.org/wp-content/uploads/Covid%2019%20Issue/Text/AEE-COVID-19-Jensen.pdf (accessed on 14 May 2023).
10. Conley, C.S.; Kirsch, A.C.; Dickson, D.A.; Bryant, F.B. Negotiating the Transition to College: Developmental Trajectories and Gender Differences in Psychological Functioning, Cognitive-Affective Strategies, and Social Well-Being. *Emerg. Adulthood* **2014**, *2*, 195–210. [CrossRef]
11. Acevedo-Ojeda, A. Integrating attention training practices (mindfulness) into engineering education during the COVID-19 pandemic. In Proceedings of the International Conference on Innovation, Documentation and Education, Lisbon, Portugal, 31 August–2 September 2022; pp. 1–8. [CrossRef]
12. Davids, T.W.R.; Stede, W. *Pali-English Dictionary*; Motilal Banarsidass: New Delhi, India, 2015.
13. Kabat-Zinn, J. *Wherever You Go, There You Are: Mindfulness Meditation in Everyday Life*; Hachette UK: London, UK, 1994.
14. Lindsay, E.K.; Creswell, J.D. Mechanisms of mindfulness training: Monitor and Acceptance Theory (MAT). *Clin. Psychol. Rev.* **2017**, *51*, 48–59. [CrossRef]
15. Creswell, J.D. Mindfulness Interventions. *Annu. Rev. Psychol.* **2017**, *68*, 491–516. [CrossRef] [PubMed]
16. Bamber, M.D.; Schneider, J.K. Mindfulness-based meditation to decrease stress and anxiety in college students: A narrative synthesis of the research. *Educ. Res. Rev.* **2016**, *18*, 1–32. [CrossRef]
17. Bamber, M.D.; Schneider, J.K. College students' perceptions of mindfulness-based interventions: A narrative review of the qualitative research. *Curr. Psychol.* **2022**, *41*, 667–680. [CrossRef]
18. Dawson, A.F.; Brown, W.W.; Anderson, J.; Datta, B.; Donald, J.N.; Hong, K.; Allan, S.; Mole, T.B.; Jones, P.B.; Galante, J. Mindfulness-Based Interventions for University Students: A Systematic Review and Meta-Analysis of Randomised Controlled Trials. *Appl. Psychol. Health Well-Being* **1959**, *12*, 384–410. [CrossRef] [PubMed]
19. Kessler, R.C.; Amminger, G.P.; Aguilar-Gaxiola, S.; Alonso, J.; Lee, S.; Üstün, T.B. Age of onset of mental disorders: A review of recent literature. *Curr. Opin. Psychiatry* **2007**, *20*, 359. [CrossRef] [PubMed]
20. Baer, R.; Crane, C.; Montero-Marin, J.; Phillips, A.; Taylor, L.; Tickell, A.; Kuyken, W.; The MYRIAD team. Frequency of Self-reported Unpleasant Events and Harm in a Mindfulness-Based Program in Two General Population Samples. *Mindfulness* **2021**, *12*, 763–774. [CrossRef] [PubMed]
21. Britton, W.B.; Lindahl, J.R.; Cooper, D.J.; Canby, N.K.; Palitsky, R. Defining and Measuring Meditation-Related Adverse Effects in Mindfulness-Based Programs. *Clin. Psychol. Sci.* **2021**, *9*, 1185–1204. [CrossRef] [PubMed]
22. Bernárdez, B.; Duran, A.; Parejo, J.A.; Juristo, N.; Ruiz-Cortés, A. Effects of Mindfulness on Conceptual Modeling Performance: A Series of Experiments. *IEEE Trans. Softw. Eng.* **2020**, *48*, 432–452. [CrossRef]
23. Chan, B.; Huerta, M.V.; Jurkiewicz, J.; Martini, L.; Bairaktavora, D. A Critical Evaluation of a Mindfulness-Based Intervention Integrated into First-year Engineering Classrooms. 2024. *manuscript submitted for publication*.
24. Higley, E. Defining Young Adulthood. *Qualif. Manuscr.* **2019**, *17*, 1–28. Available online: https://repository.usfca.edu/dnp_qualifying/17 (accessed on 14 May 2023).
25. Baer, R.A.; Smith, G.T.; Hopkins, J.; Krietemeyer, J.; Toney, L. Using Self-Report Assessment Methods to Explore Facets of Mindfulness. *Assessment* **2006**, *13*, 27–45. [CrossRef] [PubMed]
26. Bishop, S.R.; Lau, M.; Shapiro, S.; Carlson, L.; Anderson, N.D.; Carmody, J.; Segal, Z.V.; Abbey, S.; Speca, M.; Velting, D.; et al. Mindfulness: A Proposed Operational Definition. *Clin. Psychol. Sci. Pract.* **2004**, *11*, 230–241. [CrossRef]
27. Cardaciotto, L.; Herbert, J.D.; Forman, E.M.; Moitra, E.; Farrow, V. The Assessment of Present-Moment Awareness and Acceptance: The Philadelphia Mindfulness Scale. *Assessment* **2008**, *15*, 204–223. [CrossRef] [PubMed]
28. Lutz, A.; Slagter, H.A.; Dunne, J.D.; Davidson, R.J. Attention regulation and monitoring in meditation. *Trends Cogn. Sci.* **2008**, *12*, 163–169. [CrossRef] [PubMed]
29. Slutsky, J.; Rahl, H.; Lindsay, E.; Creswell, J. Mindfulness, Emotion Regulation, and Social Threat. In *Mindfulness in Social Psychology*; Routledge: London, UK, 2017; pp. 79–93. [CrossRef]
30. Baer, R.A.; Carmody, J.; Hunsinger, M. Weekly Change in Mindfulness and Perceived Stress in a Mindfulness-Based Stress Reduction Program. *J. Clin. Psychol.* **2012**, *68*, 755–765. [CrossRef] [PubMed]
31. Dey, I. *Qualitative Data Analysis: A User-Friendly Guide for Social Scientists*; Taylor & Francis: Abingdon, UK, 2005.
32. Braun, V.; Clarke, V. Thematic analysis. In *APA Handbook of Research Methods in Psychology, Vol 2: Research Designs: Quantitative, Qualitative, Neuropsychological, and Biological*; Cooper, H., Camic, P.M., Long, D.L., Panter, A.T., Rindskopf, D., Sher, K.J., Eds.; American Psychological Association: Washington, DC, USA, 2012; pp. 57–71. [CrossRef]
33. Koru Mindfulness—Meditation for College Aged Students. (n.d.). Koru Mindfulness. Available online: https://korumindfulness.org/ (accessed on 14 May 2023).
34. Barrett, L.F.; Russell, J.A. The structure of current affect: Controversies and emerging consensus. *Curr. Dir. Psychol. Sci.* **1999**, *8*, 10–14. [CrossRef]

35. Citron, F.M.M.; Gray, M.A.; Critchley, H.D.; Weekes, B.S.; Ferstl, E.C. Emotional valence and arousal affect reading in an interactive way: Neuroimaging evidence for an approach-withdrawal framework. *Neuropsychologia* **2014**, *56*, 79–89. [CrossRef] [PubMed]
36. Russell, J.A. Core affect and the psychological construction of emotion. *Psychol. Rev.* **2003**, *110*, 145–172. [CrossRef] [PubMed]
37. Dalton, E.; Estrada, T. Implementation and Feasibility of a Group Mindfulness Intervention for Undergraduate Engineering Students. *Adv. Eng. Educ.* **2023**, *11*, 53–76. [CrossRef]
38. Nolte, H.; Huff, J.; McComb, C. No time for that? An investigation of mindfulness and stress in first-year engineering design. *Des. Sci.* **2022**, *8*, e9. [CrossRef]