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Evaluating the effectiveness of MBSR on Engineering Students using PSS & STAI

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Abstract

Context

Engineering students embark on a demanding journey in higher education, facing challenges that can potentially impact their mental health and overall well-being. Often, these students are less inclined to seek help when they experience stress, which may be triggered by factors such as academic pressure, a heavy workload, and time constraints. This can pose significant risks to their mental health.

Purpose

The primary objective of this study was to assess the stress levels experienced by engineering students, implement a stress-reduction intervention, and subsequently evaluate its effectiveness in reducing stress.

Methods

A quasi-experimental design with pretest and post-test assessments was used in the study. Stress levels were measured using established scales like Perceived Stress Scale (PSS) and State-Trait Anxiety Inventory(STAI) on a sample of 50 engineering students (n=50). A Mindfulness- based stress reduction (MBSR) program was then introduced, and data was collected before and after the implementation of a stress reduction intervention.

Outcomes

The results indicated that there was a significant decrease in the overall mean of PSS and STAI score after participating in the MBSR program.

Conclusion

We conclude that the use of MBSR is effective in reducing stress among engineering students

Keywords— Stress, Engineering students, MBSR, PSS, STAI, Paired t-test

I. INTRODUCTION

In today's fast-paced world, the pursuit of innovation and financial success has become a relentless race. The allure of technological advancements and wealth generation often overshadows the importance of leading a stress-free and contented life. This phenomenon is particularly evident among students, who, under the pressure of societal expectations and academic demands, grapple with stressor that compromise their well being (Ban et al., 2022).

The contemporary era is marked by an unprecedented emphasis on innovation and money-making. Technological marvels are consistently reshaping our lives, promising convenience and advancement. While this is undoubtedly remarkable, the relentless pursuit of innovation can lead to a state of perpetual discontent. In our relentless quest for the 'next big thing, we often overlook the simple joys that life has to offer. Happiness is often elusive in this whirlwind of innovation and financial gain.

The pressure that students face today is emblematic of these societal phenomena. The modern education system places immense demands on students. Student stress can be due to heavy academic workload, complex subjects, time management challenges, competition, isolation, performance anxiety, lack of resources, career concerns, health issues, financial strains and difficulties in group projects.

Throughout its history, engineering has maintained its reputation as a challenging and rigorous academic discipline. The competitive nature of the curriculum often leads to high levels of stress among students. Recognizing that a certain level of stress is an inherent aspect of college life, it can actually contribute positively to a student's academic and personal accomplishments when managed appropriately (Oyewobi et al., 2020). Nevertheless, elevated and persistent stress levels can have adverse effects on students' mental well-being, potentially resulting in conditions such as depression, anxiety, and various forms of psychological discomfort (Negi & Khanna, 2019).Furthermore, stress serves as an early indicator of potential mental health issues among undergraduate students (Acharya et al., 2018).

Approximately 10.7% of the global population experiences daily mental health challenges, including 3.4% who contend with anxiety disorders (Auerbach et al., 2018). This phenomenon is even more pronounced among college students, where as of 2018, an estimated 35.3% of students worldwide grappled with mental health disorders, with anxiety disorders affecting 23.6% of this population (Dalvi et al., 2023).

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Under stress, students may adopt unhealthy coping mechanism, including procrastination, isolation, cheating, self harm and negative self talk. Ignoring physical health, over committing and avoiding support systems or professional help are also common maladaptive responses. There are several practices that create a holistic approach to stress reduction and MBSR is one among them.

Our paper focuses on capturing the stress levels for a set of students and apprehending certain techniques to overcome stress.

II. RELATED WORK

There are numerous scientifically tested programs that have demonstrated their effectiveness in alleviating stress among students. Some of them are Mindfulness-Based Cognitive Therapy (MBCT), Mindfulness-Based Cognitive Therapy for Children (MBCT-C), Mindfulness-Based Relapse Prevention (MBRP), Dialectical Behavior Therapy (DBT), Acceptance and Commitment Therapy (ACT), Mindful Self-Compassion (MSC), Cultivating Emotional Balance (CEB), Search Inside Yourself (SIY), iRest (Integrative Restoration), Breath works Mindfulness for Stress and Chronic Pain etc. In the midst of various options, we have selected MBSR due to its simplicity, making it easy for students to comprehend and practice.

Lee (2012) provided an in-depth overview of the Perceived Stress Scale (PSS) and its application. The PSS comprises 10 inquiries probing feelings and thoughts over the past month, gauging the level of unpredictability and overwhelm in an individual's life. Respondents rate their responses to stressful situations on a scale of 0 to 4, where 0 signifies 'Never' and 4 signifies 'Very often.' The cumulative scores yield an overall assessment of perceived stress, with individual scores ranging from 0 to 40. Higher scores correspond to elevated levels of perceived stress. Table I shows for the score interpretation.

Spielberger and colleagues (1983) were the inventors of STAI. STAI was designed to offer reliable and concise self-report assessments for calculating two types: state anxiety and trait anxiety also called as A-State and A-Trait sub-scales respectively. Table II shows the scale of scores and Table III shows the differences between the two types ofSTAI.

Yusufov and colleagues (2019) analyzed 43 global studies on stress reduction interventions for college and graduate students. Found that various approaches effectively reduce anxiety and perceived stress. The cognitive-behavioral program, social support, the coping skills work well for stress, while relaxation training and mindfulness help with anxiety. Short and long-term interventionsshow positive effects.

TABLE I
RANGE OF SCORES FOR PSS

Stress score	Levels
Range(0,13)	Meaning stress is low
Range(14,26)	Meaning stress is moderate
Range(27,40)	Meaning stress is high

TABLE II
RANGE OF SCORES FOR STAI

Stress score	Levels
Range(20,37)	Low anxiety
Range(38,44)	Moderate anxiety
Range(45,80)	High anxiety

TABLE III
SUMMARY DIFFERENCE BETWEEN A-STATE & A-TRAIT

A-State	A-Trait
Expresses current emotion state.	Expresses specific anxiety symptoms over a period of time
Aims to assess the intensity of feelings such as tension, nervousness, worry, and apprehension at a specific moment in time	This scale gauges individual variations in anxiety proneness, which means a person's general inclination to worry, particularly in situations that pose a potential threat to their self-esteem.
It tends to rise in situations like physical or psychological stress. Situations like electric shock, watching distressing films, delivering a speech, or receiving negative feedback on performance.	It will be stable over the time and less affected by physical or psychological stress.
Scores are elevated prior to surgical procedures and gradually decline during the post-surgical recovery period.	Tends to rise when faced with situations involving threats to their ego or self-esteem

Peterson and colleagues (1992) examined the Efficacy of a Meditation- Based Stress Reduction Program for Treating Anxiety Disorders. This research aimed to assess the impact of a mindfulness meditation group program on individuals with anxiety disorders. Out of 22 participants, all met the criteria for generalized anxiety disorder after undergoing a structured clinical interview.

Furthermore Hsieh and colleagues (2012) research indicate that this group significantly alleviate indicators of panic, stress and sustain these improvements for individuals with anxiety and other disorders. Hsu and colleagues (2014) proved similar theory in their work.

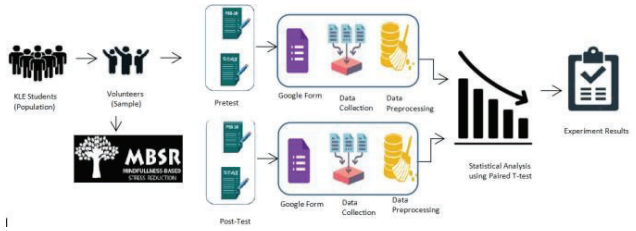

Fig. 1. System Architecture Diagram.

III. PROPOSED METHODOLOGY

A. Ethical Considerations

As per KLE University mandated informed consent form was shared with each student, which comprehensively outlined the details of this experimental study. It was made explicitly clear that their data would be gathered in an anonymous and confidential manner, solely for the purpose of the study. We conducted assessments exclusively on relevant components, and students had the freedom to discontinue their participation at any time of their choosing.

B. Random Sampling

The population under consideration was all students of KLE University, while the randomly volunteered students were selected participants who constituted the sample. A simple random sampling with a fixed sample size of 50 (Acharya et al., 2013).

C. Paired T-test

The choice of hypothesis testing method hinges on both the nature of the data and the specific research inquiry at hand.

The paired t-test and unpaired t-test serve as distinct statistical tools for comparing means across two groups. This is employed when two measurements are taken on the same individuals, typically before and after an intervention while unpaired t-test is used for comparing the means of two separate groups (Hsu & Lachenbruch, 2014).

Given the characteristics of our dataset, the paired t-test aligns more closely with our research objectives, and thus, we have chosen to it. The proposed hypotheses for the paired t-test are framed as one-tailed tests, specifically testing for a decrease in scores from pretest to post-test as shown below:

Null Hypothesis (H0): The population mean of the post-test scores (μpost) is greater than or equal to the population mean of the pre-test scores (μpre) $H0$: μpost >= μpre

Alternative Hypothesis (H1):The population mean of the post-test scores (μpost) is less than the population mean of the pre-test scores (μpre) $H1$:μpost < μpre

This setup is specifically interested in whether there is a significant decrease in scores from the pretest to the post-test. Keep in mind that this means we are not considering the possibility of an increase or no change in scores. It's a one-tailed that is test focused on a decrease.

D. Research Question and Hypothesis

Research Question: Does participating in a MBSR program lead to a significant reduction in stress levels among students?

We have devised two hypotheses to address our research inquiry

I Hypothesis: Participation in the MBSR program will lead to a statistically significant decrease in the mean PSS score among the group of 50 students, keeping the level of significance 0.05

Null Hypothesis (H0): "Participating in the MBSR program will result in either a greater than or equal to the mean PSS score among the group of 50 students (μ_after >= μ_before).
Alternative Hypothesis (H1): Participating in the MBSR program will result in a statistically significant decrease in the mean PSS score among the group of 50 students (μ_after < μ_before).

II Hypothesis: Participation in the MBSR program will lead to a statistically significant decrease in the mean STAI score among the group of 50 students, keeping the level of significance 0.05

Null Hypothesis (H0): "Participating in the MBSR program will result in either a greater than or equal to the mean STAI score among the group of 50 students (μ_after >= μ_before).
Alternative Hypothesis (H1): Participating in the MBSR program will result in a statistically significant decrease in the mean STAI score among the group of 50 students (μ_after < μ_before).

E. Stress assessments

Prior to initiating our research, we engaged in consultations with an esteemed psychologist who offered valuable insights regarding stress detection and different stress reduction programs. Among the various standard stress assessments available, the PSS & STAI were chosen based on their established effectiveness in accurately gauging stress levels and anxiety traits among the students.

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F. Data Collection

The process began by distributing links to the PSS and STAI tests to the students. They were instructed to complete both assessments and provide a screenshot of their results. Subsequently, a Pretest survey form was generated and sent out, prompting students to update their scores along with the attached screen-shots as evidence. This information was documented in the initial survey. Following this, the students were engaged in an eight-week MBSR program. Subsequently, students were asked to reattempt the PSS and STAI tests and submit their results through a Post-test survey form for recording.

Pretest link - https://forms.gle/AnZSsXWTYHpVhETc6

Post-test link - https://forms.gle/ipJVXntcvCURshvDA

Fig. 1. Shows the flow chart of our work.

G. Data Preprocessing

The data from the Pretest and Post-test forms was downloaded as a csv (comma separated values) file format that serves as a dataset to perform analysis. Following the data collection, we carried out several data preprocessing steps (Garcia et al., 2015).

1. ***Data Cleaning:*** Examined the dataset for any missing values. In the instances where students have not provided values for certain attributes, we have employed appropriate imputation methods. For numerical data, the mean or median was used, while for categorical data, the mode method has been used to ensure data completeness.
2. ***Data Integration:*** Different naming conventions emerged as issues. To ensure uniformity throughout the dataset, we standardized naming conventions. Additionally, to maintain data integrity, duplicate records were identified and removed from the dataset.

H. Exploratory Data Analysis (EDA)

In addition to the standard tests, we also asked students to answer some simple questions in the survey forms to gain some meaning full insights by performing EDA (Tukey & J. W, 1977) (Hartwig et al., 1979)

Question 1: In which of these specific events do you experience stress?

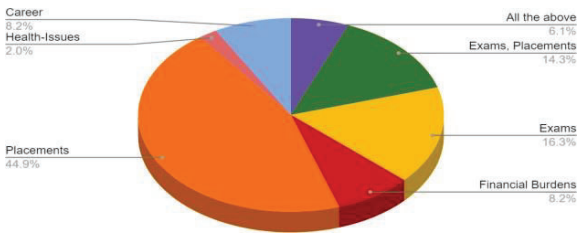

Fig. 2. Percentage of stressful events

Question 2: Did the test provide a valuable perspective?

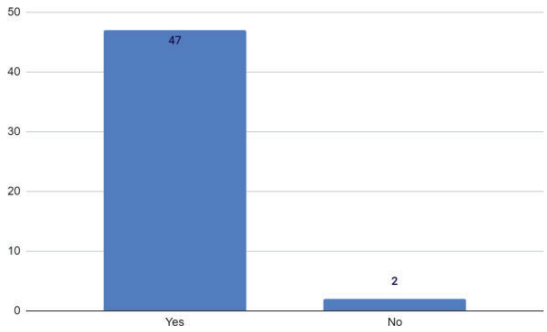

Fig. 3. Perspective about the tests

IV. RESULTS AND DISCUSSION

We first work on hypothesis I that is based on PSS score and then hypothesis II that is based on STAI score. The STAI scores are of two types A-State and A-Trait, so we perform paired t-test twice on STAI score. Table shows the resulting descriptive statistics score. Table IV shows the resulting values.

TABLE IV
DESCRIPTIVE STATISTICS USING PASS AND STAI

	PSS		A-State STAI		A-Trait STAI	
	Pretest	Post-test	Pretest	Post-test	Pretest	Post-test
Mean	19.56	16	45.52	43.52	44.68	42.22
Standard deviation	10.154	9.36	11.168	6.347	8.87	7.985
Variance	103.10	87.7	124.72	40.295	78.83	63.76
Sample Size	50	50	50	50	50	50

For PSS: The paired t-test was conducted on a PSS scores consisting of pretest and post-test scores from 50 individuals. With the values shown in table mean, standard deviation and variance for both before and after MBSR revealed a significant decrease in scores, with a mean difference of -3.56 and standard deviation of the differences of approximately 4.669. The calculated t-statistic was -5.394 with 49 degrees of freedom. At a significance level of 0.05, the critical t-value for a one-tailed test was approximately -1.676. As the calculated t-statistic was much farthest than

the critical t-value, we reject the null hypothesis. This provides strong evidence to suggest a significant decrease in scores from the pretest to the posttest. These findings indicate that the intervention or treatment implemented likely had a meaningful impact on the measured outcome.

For A-State anxiety :
The paired t-test was conducted on STAI A-state scores with all details shown in TABLE 4. The analysis unveiled a significant decrease in scores, with a mean difference of -2 and a standard deviation of the differences of approximately 6.093. The calculated t-statistic was -2.32 with 49 degrees of freedom. At a significance level of 0.05, the critical t-value for a one-tailed test with 49 degrees of freedom was approximately -1.676. Since the calculated t-statistic was more farthest than the critical t-value, we reject the null hypothesis. This implies strong evidence supporting a significant decrease in scores from the pre to post. The outcome indicate that the intervention or treatment likely had a meaningful impact on the measured outcome.

For A-Trait anxiety :
The paired t-test was conducted on STAI A-Trait containing pretest and posttest scores from 50 individuals. The pretest scores had a mean, standard deviation values shown in the table. The analysis revealed a significant decrease in scores, with a mean difference of -2.46 and a standard deviation of the differences of approximately 4.202. The calculated t-statistic was -4.143 with 49 degrees of freedom. At a significance level of 0.05, the critical t-value for a one-tailed test with 49 degrees of freedom was approximately -1.676. As the calculated t-statistic was substantially more farthest than the critical t-value, we reject the null hypothesis. This strongly suggests a significant decrease in scores from the pretest to post. The outcome indicate that the intervention or treatment likely had a meaningful impact on the measured outcome.

Therefore we conclude that in both hypothesis I and II the Null hypothesis is rejected and Alternate hypothesis is accepted, that means the post-test scores have reduced compared to pretest. This answers our research question that MBSR does help to reduce the stress for engineering students.

V. CONCLUSION AND FUTURE SCOPE

In summary, our findings indicate that engineering students commonly experience a notable degree of stress. Introducing initiatives like MBSR has shown promise in alleviating this stress. Nevertheless, it's important to acknowledge that programs like MBSR can come with a significant financial investment. As we look ahead, our goal is to pioneer a cost-effective stress reduction app tailored specifically for our students. This innovative solution aims to offer all the advantages of MBSR without imposing any financial burden.

Various other stress reduction programs, under medical supervision can be used to assess the impact of stress level.

REFERENCES

Ban, N., Shannon, H., Wright, C. J., Miller, M. E., Hargis, L. E., Usher, E. L., ... & Wilson, S. A. (2022, January). Identifying common perceived stressors and stress-relief strategies among undergraduate engineering students. In *ASEE annual conference exposition*.

Iraola-Real, I., Nolberto-Quispe, L., Soto, A. C. Z., & Del Rosario, H. (2020, December). Predictors of the Test Anxiety in Systems Engineering and Chemical Engineering Students. In *2020 IEEE Congreso Bienal de Argentina (ARGENCON)* (pp. 1-4). IEEE.

Oyewobi, L. O., Bolarin, G., Oladosu, N. T., & Jimoh, R. A. (2020). Influence of stress and coping strategies on undergraduate students' performance. *Journal of Applied Research in Higher Education*, *13*(4), 1043-1061.

Negi, A. S., Khanna, A., & Aggarwal, R. (2019). Psychological health, stressors and coping mechanism of engineering students. *International Journal of Adolescence and Youth*, *24*(4), 511-520.

Acharya, L., Jin, L., & Collins, W. (2018). College life is stressful today–Emerging stressors and depressive symptoms in college students. *Journalof American college health*, *66*(7), 655-664.

Auerbach, R. P., Mortier, P., Bruffaerts, R., Alonso, J., Benjet, C., Cuijpers, P., ... & Kessler, R. C. (2018). WHO world mental health surveys international college student project: prevalence and distribution of mental disorders. *Journal of abnormal psychology*, *127*(7), 623.

Dalvi, A., Kapur, P., Ashtekar, R., Gorugantu, A., & Siddavatam, I. (2023, March). Transforming College Counseling: An In-House Solution for Student Mental Wellness. In *2023 2nd International Conference for Innovation in Technology (INOCON)* (pp. 1-5). IEEE.

Lee, E. H. (2012). Review of the psychometric evidence of the perceived stress scale. *Asian nursing research*, *6*(4), 121-127.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). Manual for the State-Trait Anxiety Inventory; Palo Alto, CA, Ed. *Palo Alto: Spielberger*.

Nigussie, S., Belachew, T., & Wolancho, W. (2014). Predictors of preoperative anxiety among surgical patients in Jimma University specialized teaching hospital, South Western Ethiopia. *BMC surgery*, *14*,1-10.

Yusufov, M., Nicoloro-SantaBarbara, J., Grey, N. E., Moyer, A., & Lobel, M. (2019). Meta-analytic evaluation of stress reduction interventions for undergraduate and graduate students. *International Journal of Stress Management*, *26*(2), 132.

Peterson, L. G., & Pbert, L. (1992). Effectiveness of a meditation-based stress reduction program in the treatment of anxiety disorders. *Am J Psychiatry*, *149*(7), 936-943.

Hsieh, P. H., Sullivan, J. R., Sass, D. A., & Guerra, N. S. (2012). Undergraduate engineering students' beliefs, coping strategies, and academic performance: An evaluation of theoretical models. *The Journalof Experimental Education*, *80*(2), 196-218.

https://doi.org/10.52202/073963-0024

Hsu, H., & Lachenbruch, P. A. (2014). Paired t test. *Wiley StatsRef: statistics reference online*.

Acharya, A. S., Prakash, A., Saxena, P., & Nigam, A. (2013). Sampling: Why and how of it. *Indian Journal of Medical Specialties*, *4*(2), 330-333.

García, S., Luengo, J., & Herrera, F. (2015). *Data preprocessing in data mining* (Vol. 72, pp. 59-139). Cham, Switzerland: Springer InternationalPublishing.

Tukey, J. W. (1977). *Exploratory data analysis* (Vol. 2, pp. 131-160).

Hartwig, F., & Dearing, B. E. (1979). *Exploratory data analysis* (No. 16). Sage.

https://doi.org/10.52202/073963-0024