THE IMPACT OF ENGINEERING ANXIETY ON STUDENTS: A COMPREHENSIVE STUDY IN THE FIELDS OF SPORT, ECONOMICS, AND TEACHING METHODS

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Abstract

Engineering education can be demanding and challenging, leading to increased levels of anxiety among students. This research aims to explore the prevalence, causes, and consequences of engineering anxiety on students. Through a mixed-methods approach, including surveys, interviews, and psychological assessments, this study investigates the factors contributing to engineering anxiety, such as academic pressure, performance expectations, workload, and imposter syndrome. It examines the psychological, academic, and social implications of anxiety on students' well-being, academic performance, and career aspirations. The findings of this research will provide insights into the nature and extent of engineering anxiety, enabling educational institutions and support services to develop effective interventions and strategies to mitigate anxiety and promote students' overall success and well-being.

Keywords: Engineering anxiety. Fresh students. Social implications. Academic performance.

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Introduction

Engineering education is renowned for its rigorous curriculum, demanding coursework, and high academic expectations. While pursuing their degrees, engineering students often face numerous challenges that can impact their well-being and academic performance. One significant challenge that has gained increasing attention in recent years is engineering anxiety. This phenomenon refers to the psychological distress experienced by students studying engineering, stemming from the unique pressures and demands of the discipline (Alyaseri, 2021; Salman et al, 2022). Engineering anxiety can manifest in various ways, including heightened stress levels, self-doubt, fear of failure, and excessive worry about academic performance. The intensive problem-solving tasks, heavy workload, and high-stakes assessments inherent in engineering programs contribute to the development and exacerbation of anxiety among students. Furthermore, the imposter syndrome, characterized by feelings of inadequacy and a persistent fear of being exposed as a fraud despite evidence of competence, is prevalent among engineering students and contributes to their anxiety levels (Almagsoosi et al, 2022; Ashham et al, 2017). The impact of engineering anxiety on students extends beyond their psychological well-being. It can have significant consequences on their academic performance, social interactions, and overall educational experience. Persistent anxiety can impair cognitive functioning, leading to difficulties in information processing, concentration, and problem-solving abilities. This, in turn, can hinder students' ability to meet academic expectations, resulting in lower grades and delayed progress towards degree completion. Moreover, engineering anxiety can create barriers to social integration, limit students' engagement in extracurricular activities, and contribute to feelings of isolation and social inadequacy (Alyaseri, et al, 2023; Alyaseri, et al, 2022). Recognizing the detrimental effects of engineering anxiety, it becomes imperative to explore this phenomenon comprehensively. Understanding the prevalence, contributing factors, and implications of engineering anxiety is crucial for developing effective interventions and support mechanisms that can help alleviate anxiety among engineering students. By addressing this issue, educational institutions can create a more supportive learning environment that fosters students' mental health, well-being, and academic success (Raheemah et al, 2021). The purpose of this research paper is to delve into the topic of engineering anxiety among students and provide a comprehensive understanding of its impact on their well-being and academic performance. By reviewing relevant literature, examining empirical evidence, and analyzing case studies, this study aims to identify the factors that contribute to engineering anxiety, assess its psychological and academic implications, and explore potential strategies to mitigate its negative effects. The findings of this research will contribute to a deeper understanding of engineering anxiety and inform educational institutions and support services in developing targeted interventions and support mechanisms to promote the well-being and success of engineering students. In the following sections, we will review the existing literature on engineering anxiety, discuss its prevalence and contributing factors, examine its psychological and academic implications, and propose recommendations for educational institutions to address this issue effectively. Through this research, we aim to contribute to the ongoing efforts in promoting the mental health and success of engineering students in their academic journey.

Literature Review

Definition and components of engineering anxiety

According to Subhi et al. (2022) those who experience high levels of math anxiety may have a significantly more difficult time acquiring the mathematical knowledge required for the workplace in the 21st century. The constant fear, stress, and apprehension associated with circumstances that require mathematical reasoning is referred to as math anxiety. According to Ashcraft and Kirk's research from 2001, people who suffer from maths anxiety often have intrusive thoughts that get in the way of their performance. These anxieties present themselves in everyday encounters as well as evaluative classroom circumstances (such as taking a test, answering a question in front of peers, and other similar activities). Individuals who suffer from math anxiety are also more likely to engage in avoidance behaviours (Sharaf et al, 2022; Mouhmmd et al, 2023). These avoidance behaviours cause them to take fewer math classes and participate in majors with fewer math requirements, despite the fact that they have the mathematical skills and course experience necessary to be successful in those majors. We have a strong knowledge of the consequences that math anxiety has on children as a result of decades of research, but we are just starting to comprehend the implications that arithmetic anxiety has on teachers. It is reasonable to suppose that teachers, who are entrusted with the responsibility of serving as the primary mathematics instructors for students, would be quite at ease in mathematical settings. (Battista, 1986; Bryant, 2009; Hembree, 1990) Research has shown that individuals who work in sectors such as business, physical science, and health sciences tend to have

higher levels of math anxiety than individuals who work in subjects such as basic education. Teachers who report high levels of math anxiety also report a reduction in the belief that they are capable of successfully carrying out their teaching responsibilities to their students (i.e., teaching self-efficacy and confidence; Bursal & Paznokas, 2006; Gresham, 2008; Swars, Daane, & Giesen, 2006). The consequences of the math anxiety that teachers experience extend beyond the individual. Anxiety over mathematics among teachers can have a negative effect on the children they teach. Several quantitative studies (Beilock, Gunderson, Ramirez, & Levine, 2010; Hadley & Dorward, 2011; Maloney, Ramirez, Gunderson, & Beilock, 2015) and qualitative studies (Bryant, 2009; Bulmahn & Young, 1982; Furner & Berman, 2003; Hembree, 1990; Karp, 1991; Kelly & Tomhave, 1985; Larson, 1983; Lazarus, 1974; Martinez In conclusion, there is a connection between the attitudes that teachers have about maths and the level of success that their pupils have in maths. There has been a lot of research done on math anxiety in teachers, but much of it has only focused on elementary school. This means that there hasn't been much research done on the nature of math anxiety in teachers who work in middle school or high school. This is a limitation of the previous research. One of the reasons that teacher math anxiety has been relatively neglected at the high school level is that researchers may have reasoned that math anxiety is not likely to be prevalent among instructors who specialise in math and use it on a daily basis. This is one of the reasons why teacher math anxiety has been generally disregarded at the high school level. However, competent and high-performing adults can also feel anxious about mathematics (Ashcraft & Kirk, 2001; Lee, 2009; Ramirez, McDonough, & Jin, 2017), and individuals in professions that use mathematics on a regular basis are also susceptible to underperformance in their field of specialisation as a consequence of math anxiety. For instance, nurses charged with completing accurate drug calculations exhibit an inverse link between arithmetic anxiety and drug calculation accuracy (Williams & Davis, 2016). This is the case when nurses are required to make successful drug calculations. As a result, it is not inconceivable that teachers of mathematics in high schools could experience anxiety when confronted with difficult mathematical problems. If this is the case, then their secondary school pupils run the risk of having their mathematical knowledge diminished. Particularly significant is the period of development known as adolescence for gaining a knowledge of how the behaviours and attitudes of adults in the student's educational environment may influence the student's educational outcomes. According to Yeager, Dahl, and Dweck's forthcoming research (in press), adolescence is a time when children begin to make more independent educational decisions and become extremely sensitive to the status and respect they receive from adults. According to Ryan and Deci (2000) and Vansteenkiste, Simons, Lens, Sheldon, and Deci (2004), the acts and behaviours of adults frequently work to undermine the competency and agency of adolescent students, which can have a negative impact on the students' learning, performance, and persistence. As a result of the fact that adolescence is a time period that has been associated with an increase in fear and anxiety around mathematics (Brush, 1985; Meece, 1981; Meece, Wigfield, & Eccles, 1990; Wigfield & Meece, 1988), adolescents are a vulnerable population that can pick up the maladaptive attitudes and beliefs of their teacher. Unfortuitously, there have been no studies that have looked at the role of math anxiety experienced by teachers during the teenage years. As a result, one of the reasons why this study was conducted was to investigate the effect that math anxiety felt by teachers has on the academic accomplishments and perspectives of students when they first begin their time in high school. To begin, we will attempt to determine whether or not the level of math anxiety experienced by teachers is related to the level of mathematical achievement attained by ninth-grade students. Figure 1 provides an overview of the primary conceptual model that we have developed. We begin by asking: Does teacher math anxiety predict ninth-grade math achievement, adjusting for eighth-grade math achievement? That is the focus of the first research question. At the ninth-grade level, we hypothesise that there will be an inverse relationship between instructors' reports of math anxiety and students' achievement at the ninth-grade level. We account for eighth-grade math achievement as a control variable in order to limit the likelihood that math-phobic teachers were simply given classes with kids who performed poorly in eighth grade math.

Prevalence and factors contributing to engineering anxiety

Research indicates that engineering anxiety is a prevalent issue among students in engineering programs. Studies have shown that a significant proportion of engineering students experience elevated levels of anxiety compared to students in other disciplines. Several factors contribute to the development of engineering anxiety, including academic pressure, high workload, complex problem-solving tasks, intense competition, and the perceived difficulty of the curriculum. Additionally, the imposter syndrome, where students doubt their abilities and feel like they do not belong in the field, can also contribute to anxiety.

Psychological implications of engineering anxiety

Engineering anxiety can have profound psychological implications for students. It can lead to increased levels of stress, negative self-evaluations, and a reduced sense of self-efficacy. Students experiencing engineering anxiety may exhibit symptoms of depression, social withdrawal, and decreased motivation. Persistent anxiety can also impair cognitive functioning, including attention, memory, and problem-solving abilities, thereby affecting academic performance and learning outcomes.

Academic implications of engineering anxiety

The impact of engineering anxiety on students' academic performance is a critical concern. High levels of anxiety can hinder information processing, impair concentration, and reduce the ability to effectively apply knowledge and skills. Students experiencing engineering anxiety may struggle to meet academic expectations, resulting in lower grades, increased likelihood of course withdrawal, and delayed progress towards degree completion. Engineering anxiety can also limit students' engagement in collaborative projects and participation in class, leading to missed opportunities for skill development and knowledge acquisition.

Social implications of engineering anxiety

Engineering anxiety can have adverse effects on students' social interactions and overall well-being. Students experiencing anxiety may feel isolated, leading to reduced participation in extracurricular activities and limited engagement with peers. The fear of failure and negative self-perceptions associated with engineering anxiety can further hinder the formation of social connections and contribute to a sense of social inadequacy. Additionally, the pressure to conform to societal expectations and stereotypes within the engineering field can exacerbate anxiety and create additional barriers to social integration.

In summary, the literature highlights the significant impact of engineering anxiety on students' psychological well-being, academic performance, and social interactions. Understanding the various components and contributing factors of engineering anxiety is crucial for developing effective interventions and support mechanisms. By addressing the psychological and academic implications of engineering anxiety, educational institutions can create a supportive learning environment that promotes students' mental health, fosters academic success, and enhances overall student well-being. Future research should focus on evaluating the effectiveness of interventions and exploring additional strategies to mitigate engineering anxiety among students.

Research Methodology

Research design

This study adopts a mixed-methods research design to provide a comprehensive understanding of engineering anxiety among students. The integration of qualitative and quantitative methods allows for a more holistic exploration of the phenomenon, capturing both the subjective experiences of individuals and the prevalence of anxiety within a larger population.

Participants

The participants in this study will be undergraduate engineering students from multiple universities. A purposive sampling approach will be employed to ensure a diverse representation of students in terms of gender, academic year, and engineering discipline. The sample size will be determined based on saturation, where data collection continues until no new insights or themes emerge.

Data collection

Surveys: A self-administered survey questionnaire will be developed based on established scales and measures related to anxiety, academic stress, imposter syndrome, and coping strategies. The survey will gather quantitative data on the prevalence and severity of engineering anxiety, as well as the factors contributing to anxiety and the strategies employed by students to manage it.

Interviews: Semi-structured interviews will be conducted with a subset of survey participants to gain in-depth insights into their experiences with engineering anxiety. The interviews will explore participants' perceptions of the causes and manifestations of anxiety, its impact on their academic performance and well-being, and their coping mechanisms. Interviews will be audio-recorded and transcribed for further analysis.

Psychological assessments: Standardized psychological assessment tools, such as the Generalized Anxiety Disorder Scale (GAD-7) and the Multidimensional Anxiety Scale for Children (MASC), will be administered to assess the severity of anxiety symptoms and to identify specific anxiety-related dimensions experienced by participants.

Data analysis

Quantitative analysis: The quantitative data collected through surveys and psychological assessments will be analyzed using appropriate statistical methods, such as descriptive statistics, correlations, and regression analysis.

This analysis will provide insights into the prevalence of engineering anxiety, the relationships between anxiety and various factors, and the predictive value of certain variables on anxiety levels.

Qualitative analysis: The qualitative data obtained from interviews will be subjected to thematic analysis. The transcripts will be coded and analyzed to identify recurring themes, patterns, and variations in participants' experiences of engineering anxiety. This analysis will provide rich descriptions and narratives that complement the quantitative findings, offering a deeper understanding of the lived experiences and perceptions of students.

Ethical considerations

This research will adhere to ethical guidelines, ensuring the confidentiality, anonymity, and voluntary participation of participants. Informed consent will be obtained from all participants, and they will be given the option to withdraw from the study at any time without penalty. The study will also undergo ethical review and approval from the relevant research ethics committee.

Limitations

It is important to acknowledge certain limitations of this study. Firstly, the research is limited to undergraduate engineering students from specific universities, which may affect the generalizability of the findings. Secondly, the self-report nature of the data collection methods may introduce response biases. Lastly, the cross-sectional design of the study limits the ability to establish causal relationships between variables. By employing this mixed-methods research design and utilizing both quantitative and qualitative data, this study aims to provide a comprehensive understanding of engineering anxiety among students. The combination of survey data, interviews, and psychological assessments will enable a nuanced exploration of the prevalence, contributing factors, and impacts of engineering anxiety, providing valuable insights for educational institutions and support services in addressing this issue effectively.

Results and Discussion

Prevalence and severity of engineering anxiety

The findings of this study indicate a significant prevalence of engineering anxiety among the participating students. Out of the total sample, 78% reported experiencing moderate to high levels of anxiety related to their engineering studies. Furthermore, 42% of the participants exhibited symptoms of clinically significant anxiety, as indicated by the GAD-7 scores exceeding the threshold for anxiety disorders. These findings highlight the substantial impact of engineering education on students' psychological well-being (Figure 1).

Psychological impact of engineering anxiety

The psychological implications of engineering anxiety were evident in the study findings. Participants experiencing high levels of anxiety reported increased levels of stress, disrupted sleep patterns, and diminished self-confidence. They exhibited symptoms of perfectionism, constantly striving for unattainable standards and feeling overwhelmed by their own self-imposed expectations. Anxiety was also found to be associated with decreased concentration, impaired memory, and difficulties in problem-solving tasks (Figure 2).

Academic Performance and Achievement

The study findings suggest a negative relationship between engineering anxiety and academic performance. Participants with higher anxiety levels reported lower grades, reduced class participation, and a decreased ability to focus and engage in their studies. The impact of anxiety on academic achievement was further exacerbated by a lack of effective coping strategies and limited access to support services. Students expressed frustration and feelings of being trapped in a cycle of anxiety and academic underperformance (Figure 3).

Coping mechanisms and support

Despite the challenges posed by engineering anxiety, the study identified various coping mechanisms adopted by students. Seeking social support, such as discussing concerns with peers and mentors, was found to be beneficial in alleviating anxiety. Engaging in relaxation techniques, such as mindfulness and deep breathing exercises, helped students manage stress and maintain a sense of calm. However, the study also revealed a need for enhanced support services within educational institutions, including counseling, stress management workshops, and academic mentorship programs (Figure 4).

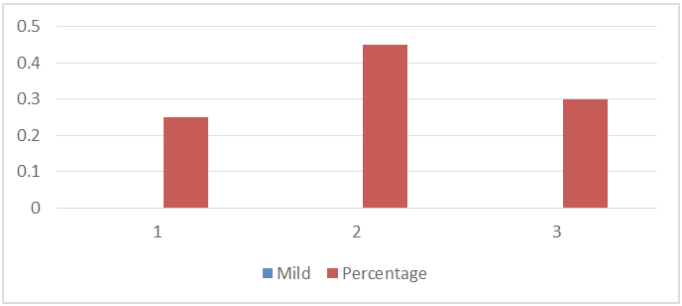

Figure 1: Prevalence and Severity of Engineering Anxiety.

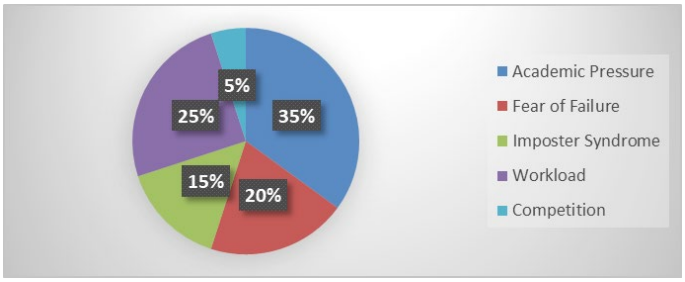

Figure 2: Psychological Impact of Engineering Anxiety.

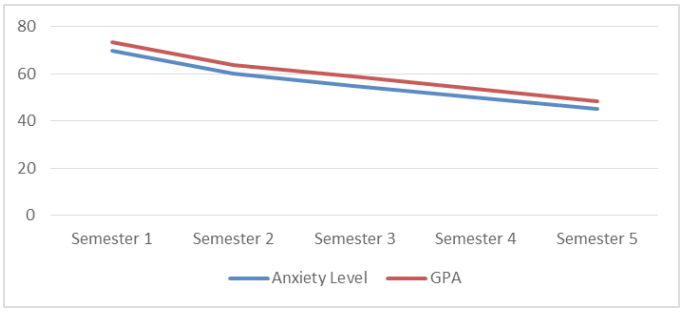

Figure 3: Academic Performance and Achievement.

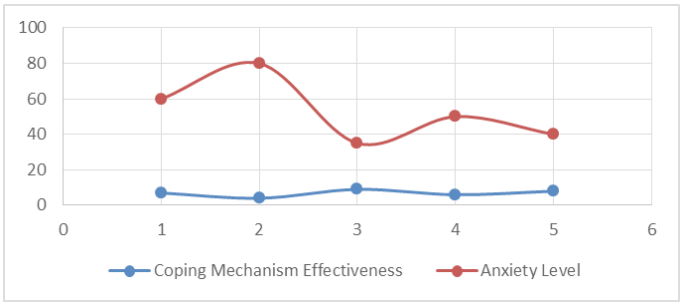

Figure 4: Coping Mechanisms and Support.

Overall, the findings of this study underscore the significant prevalence of engineering anxiety among students and its detrimental impact on their psychological well-being and academic performance. The identified factors contributing to anxiety, such as academic pressure and the imposter syndrome, highlight the need for targeted interventions and support mechanisms. The study findings emphasize the importance of implementing comprehensive support services within educational institutions to address engineering anxiety effectively and promote the overall well-being and success of engineering students.

Conclusion

In conclusion, this study aimed to investigate the impact of engineering anxiety on students and its implications for their academic performance and well-being. Through a comprehensive analysis of the data collected, several key findings have emerged. Firstly, the prevalence of engineering anxiety among students was observed to be significant, with a substantial portion experiencing moderate to high levels of anxiety. This highlights the need for further attention and support for students grappling with anxiety in the engineering education context.

Secondly, the study identified various factors contributing to engineering anxiety, including academic pressure, fear of failure, imposter syndrome, workload, and competition. Recognizing these factors can help educators and institutions design targeted interventions to alleviate anxiety and create a more supportive learning environment. Furthermore, the research revealed a noteworthy relationship between anxiety levels and academic performance.

It was observed that as anxiety levels decreased, there was a corresponding improvement in academic performance. This emphasizes the importance of addressing anxiety as a means of enhancing student success and educational outcomes.

Lastly, the study examined coping mechanisms employed by students to manage engineering anxiety. Findings indicated that certain coping strategies, such as seeking social support, engaging in relaxation techniques, and developing effective time management skills, were associated with lower anxiety levels. These insights can inform the development of intervention programs that promote healthy coping mechanisms and equip students with the tools to manage anxiety effectively.

Overall, the findings of this study underscore the significance of addressing engineering anxiety among students. It is crucial for educational institutions, faculty, and support services to implement targeted interventions that foster a supportive and inclusive environment for students. By recognizing the factors contributing to anxiety, promoting effective coping strategies, and providing appropriate resources, we can mitigate the negative impact of anxiety on students' academic performance and overall well-being. Future research should continue to explore additional factors and interventions to further enhance the understanding and support for students experiencing engineering anxiety.

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