

Exploring the Relationship Between Student Stress and Academic Achievement By using Machine Learning Techniques

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Abstract:

This study investigates the relationship between student stress factors and academic performance. Stress among students is a pervasive issue in educational settings and has been linked to various negative outcomes, including poor academic performance. Understanding the factors that contribute to student stress and their impact on academic achievement is crucial for developing effective interventions and support systems. This research employs quantitative methods to analyze data collected from a sample of students, examining the correlation between stress levels and academic performance. Additionally, the study explores specific stressors commonly experienced by students, such as workload, time management, social pressures, and financial concerns, and their influence on academic success. The findings of this study contribute to the existing literature on student well-being and academic performance, providing insights for educators, policymakers, and other stakeholders to address student stress effectively and promote better academic outcomes.

Keywords: Student stress, academic performance, stress factors, education, student well-being, intervention.

1. Introduction:

In today's educational landscape, student stress has emerged as a significant concern affecting academic performance and overall well-being. With increasing academic demands, competition, and societal pressures, students often face a myriad of stressors that can impact their ability to succeed academically. Understanding the relationship between student stress factors and academic performance is essential for educators, administrators, policymakers, and other stakeholders to implement effective strategies and interventions to support student success.

The prevalence of stress among students is well-documented, with numerous studies highlighting its detrimental effects on physical health, mental health, and academic achievement. High levels of stress can lead to anxiety, depression, burnout, and other mental health disorders, which in turn can hinder students' ability to concentrate, learn, and perform well academically. Moreover, chronic stress can contribute to absenteeism, procrastination, and disengagement from academic activities, further exacerbating academic difficulties. While stress is a universal experience, the sources and manifestations of stress vary among students. Common stressors include academic workload, deadlines, exams, competition for grades, financial pressures, relationship issues, and social expectations. These stressors can interact in complex ways, creating a unique and individualized experience of stress for each student.

Despite the clear impact of stress on academic performance, there remains a gap in understanding the specific mechanisms through which stress affects student achievement. By identifying and analyzing the various stress factors that influence academic performance, educators and policymakers can develop targeted interventions to alleviate stress and promote student success.

Research Methodology

Research Area

This study employs a quantitative research methodology to investigate the intricate relationship between student stress factors and academic performance. Adopting a cross-sectional design, data is collected from a purposive sample of students representing diverse demographic backgrounds and educational settings. Participants are selected

based on predetermined inclusion criteria, ensuring a comprehensive representation of the student population. Data collection involves the administration of self-report measures, including standardized surveys and questionnaires, to assess student stress levels, academic performance indicators, and demographic information. Established instruments such as the Perceived Stress Scale (PSS) are utilized to measure stress levels, while academic performance is evaluated through GPA, standardized test scores, and self-reported grades. Quantitative data analysis techniques, including descriptive statistics and inferential tests such as correlation analysis and regression analysis, are employed to explore the relationship between stress factors and academic performance. Ethical considerations are paramount throughout the research process, with measures implemented to safeguard participant confidentiality and uphold ethical standards. By employing a rigorous quantitative approach, this study aims to provide valuable insights into the factors influencing student well-being and educational outcomes.

K. Saoane Thach, "A Qualitative Analysis of User Reviews on Mental Health Apps: Who Used it? for What? and Why?,"

The evidence of effectiveness of Cognitive Behavioral Therapy (CBT) based mental health applications is shown to be equivalent with face-to-face CBT. Although there is a high number of users, the adherence of users to the intervention is low. Meanwhile, user non-adherence could happen on purpose. However, the reasons for this circumstance are not well examined, particularly from a user's perspective. The question of which features engage them to use as well as to continue using these interventions are not well understood. From the designer's perspective, to answer this question, it is essential to understand the context of app uses, particularly, three precedent questions: who are intended users, what they use it for, and why they use it need to be examined. This study answers these three questions by analyzing user reviews of several sample mental health applications which the core design is primarily based on a CBT. The qualitative analysis indicates that most of reviews are from people with common MH problems. Some people simply use the app to relax, track their mood, practice mindfulness, self-care, or build healthy habits. The majority of users have used the apps as complementary to the professional-based treatment. Users use the app because it makes them more positive, happy, self-conscious, calm, fun, focused, relaxed, motivated, mindful, self-controlled or better at sleep. Importantly, they highly appreciate the ability to figure out what going on their health, to help them keep on progress of health, to see correlation between causes and effects of their health problems, to conduct self-evaluation and self-reflection, to learn good things, to build good habits, and to provoke, reframe, and organize their thoughts. These findings will help the designers think of appropriate approaches to design the app which helps users better at achieving their targets.

R. A. Rahman, K. Omar, S. A. Mohd Noah, M. S. N. M. Danuri and M. A. Al-Garadi, "Application of Machine Learning Methods in Mental Health Detection: A Systematic Review,"

This paper presents a critical assessment analysis on mental health detection in Online Social Networks (OSNs) based on the data sources, machine learning techniques, and feature extraction method. The appropriateness of the mental health detection was also investigated by identifying its data analysis method, comparison, challenges, and limitations. This study reviewed articles published in major databases between 2007 and 2018 through keyword searches. The articles were screened base on their titles and abstracts before the full texts were reviewed. The articles were coded in accordance with data set (e.g., data sources, keywords, and geographical locations), method of data analysis, machine learning or deep learning technique, classifier performance, and feature extraction method. 22 articles were selected for review from the total of 2770. As OSNs exhibit high potential as a data source in early detection of mental health problems, most researchers used text analysis on a new data set extracted from different OSNs sources. The extracted data were examined using a statistical analysis or machine learning techniques. Several studies also applied multimethod techniques, which included distributing questionnaires while requesting for the respondents' consent to later access and extract information from his/her OSNs account. Big data in OSNs contribute on mental health problem detection. The presented method is an alternative approach to the early detection of mental health problems rather than using traditional strategies, such as collecting data through questionnaires or devices and sensors, which are time-consuming and costly. However, mental health problem detection through OSNs necessitates a comprehensive adoption, innovative algorithms, and computational linguistics to describe its limitations and challenges. Moreover, referrals from mental health specialists as subject matter experts are also required to help obtain accurate and effective information.

U. S. Reddy, A. V. Thota and A. Dharun, "Machine Learning Techniques for Stress Prediction in Working Employees,"

Stress disorders are a common issue among working IT professionals in the industry today. With changing lifestyle and work cultures, there is an increase in the risk of stress among the employees. Though many industries and corporates provide mental health related schemes and try to ease the workplace atmosphere, the issue is far from control. In this paper, we would like to apply machine learning techniques to analyze stress patterns in working adults and to narrow down the factors that strongly determine the stress levels. Towards this, data from the OSMI mental health survey 2017 responses of working professionals within the tech-industry was considered. Various Machine

Learning techniques were applied to train our model after due data cleaning and preprocessing. The accuracy of the above models was obtained and studied comparatively. Boosting had the highest accuracy among the models implemented. By using Decision Trees, prominent features that influence stress were identified as gender, family history and availability of health benefits in the workplace. With these results, industries can now narrow down their approach to reduce stress and create a much comfortable workplace for their employees.

3 Existing System

The existing system regarding student stress and its impact on academic performance reflects a multifaceted landscape influenced by various factors. Educational institutions typically offer support services such as counseling centers, academic advising, and wellness programs to address student stress. Additionally, faculty members may implement pedagogical strategies aimed at reducing stress, such as flexible deadlines, workload management techniques, and fostering a supportive learning environment. However, despite these efforts, student stress remains a pervasive issue, often exacerbated by external pressures such as societal expectations, financial constraints, and personal challenges. Moreover, the effectiveness of existing interventions in mitigating stress and improving academic outcomes may vary, highlighting the need for continuous evaluation and adaptation of support systems. Understanding the strengths and limitations of the existing system is crucial for identifying gaps and implementing targeted interventions to better support student well-being and academic success.

Algorithms

Data Analysis and Modeling: Algorithms can be employed to analyze large datasets containing information about student stress levels, academic performance metrics, and various contributing factors such as workload, social interactions, and health status. Machine learning algorithms, for instance, can help identify patterns and correlations within the data to understand how different stress factors impact academic performance.

Predictive Modeling: Algorithms can be used to develop predictive models that forecast how specific stressors might affect academic outcomes. By training machine learning models on historical data, educators and policymakers can gain insights into which stress factors are most influential and how they interact to influence academic performance. These predictive models could help identify at-risk students who may need additional support.

Optimization Algorithms: Optimization algorithms can be employed to design interventions and strategies aimed at reducing student stress and improving academic performance. For example, algorithms could optimize class schedules to minimize workload-induced stress, or they could allocate resources for support services such as counseling or tutoring more efficiently based on predicted student needs.

Feedback Systems: Algorithms can power feedback systems that provide real-time information to students about their stress levels and academic progress. By integrating wearable devices, mobile apps, or online platforms with algorithms that analyze physiological or behavioral data, students can receive personalized recommendations and interventions to manage stress and enhance learning outcomes.

Personalized Learning Platforms: Algorithms can drive personalized learning platforms that adapt educational content and activities based on individual student characteristics, including stress levels and learning preferences. By incorporating algorithms for adaptive learning, educators can tailor instruction to better accommodate students' needs, potentially reducing stress and improving academic performance.

Natural Language Processing (NLP): NLP algorithms can analyze written or spoken text to identify signs of stress or emotional distress in students' communications. By monitoring students' online discussions, essays, or feedback forms, NLP algorithms can detect patterns indicative of stress and alert educators or support staff to intervene proactively.

4. Proposed system

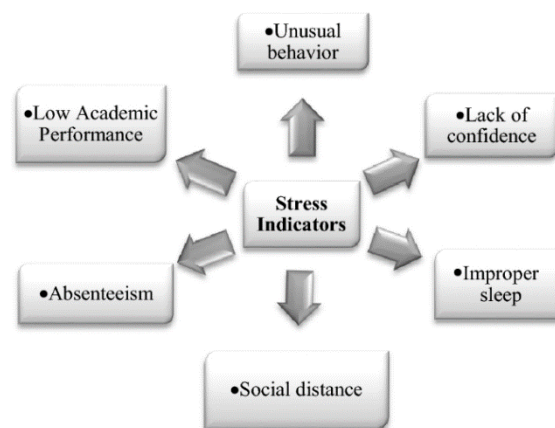
Our proposed system aims to analyze the intricate relationship between student stress factors and academic performance. Through comprehensive data collection encompassing academic records, surveys, health data, and demographic information, we will preprocess and clean the data to ensure accuracy. Employing exploratory data analysis techniques, we'll unearth insights into key stressors and their impact on academic outcomes. Leveraging machine learning models, including regression and classification algorithms, we will develop predictive models to forecast academic performance based on stress-related features. Model evaluation will be conducted rigorously,

employing techniques such as cross-validation to ensure robustness. The results of this analysis will be presented through an interactive dashboard, facilitating stakeholders such as educators and administrators to glean actionable insights. Continuous feedback mechanisms will enable iterative improvements, ensuring the system remains relevant and effective. Ethical considerations regarding privacy and data security will be paramount throughout the development and implementation process.

5. Methodology

Our methodology involves a multi-stage process to comprehensively investigate the relationship between student stress factors and academic performance. Initially, we will conduct extensive literature reviews to identify relevant theories, frameworks, and previous studies. Following this, we will gather data from diverse sources, including academic records, surveys, and health assessments, ensuring a broad representation of student demographics and stressors. The collected data will undergo preprocessing to address inconsistencies and missing values. Subsequently, we will employ exploratory data analysis techniques to uncover patterns, trends, and correlations within the dataset. Based on these findings, we will develop predictive models using machine learning algorithms to forecast academic performance based on stress-related features. Model performance will be rigorously evaluated using cross-validation and appropriate performance metrics. Finally, the results will be interpreted and presented to stakeholders through visualizations and reports, with an emphasis on actionable insights for educators and policymakers. Continuous refinement and validation of the methodology will be pursued to ensure robustness and reliability.

Architecture:



1. **Data Collection Module:** This module is responsible for gathering data from various sources such as academic records, surveys, and health assessments. It ensures the comprehensive collection of relevant information related to student stress factors and academic performance.
2. **Data Preprocessing Module:** Once the data is collected, this module preprocesses it to handle missing values, outliers, and inconsistencies. It standardizes data formats and resolves discrepancies to ensure data quality and consistency for further analysis.
3. **Exploratory Data Analysis (EDA) Module:** This module performs exploratory data analysis techniques to gain insights into the distribution, relationships, and patterns within the dataset. It visualizes the data through charts, graphs, and statistical summaries to identify trends and correlations.
4. **Feature Engineering Module:** This module identifies and creates relevant features or variables from the dataset that may influence student stress levels and academic performance. It involves transforming existing features or creating new ones to enhance the predictive power of the models.
5. **Machine Learning Models Module:** In this module, various machine learning models such as regression, classification, and ensemble methods are developed to predict academic performance based on stress-related features. These models are trained, tested, and evaluated using appropriate techniques.
6. **Model Evaluation Module:** This module evaluates the performance of the trained machine learning models using metrics such as accuracy, precision, recall, F1-score, and area under the ROC curve (AUC). It ensures the reliability and effectiveness of the predictive models.
7. **Interpretation and Insights Module:** Once the models are evaluated, this module interprets the results to understand the relationship between student stress factors and academic performance. It identifies significant stressors and their impact on academic outcomes, providing actionable insights for stakeholders.

6. Conclusion:

In conclusion, the proposed system offers a comprehensive approach to understanding the intricate relationship between student stress factors and academic performance. By leveraging data collection, preprocessing, exploratory

data analysis, machine learning modeling, and interpretation modules, the system enables stakeholders to gain valuable insights into the underlying factors influencing student well-being and educational outcomes. Through predictive modeling and evaluation, actionable insights are provided to educators, administrators, and policymakers, empowering them to implement targeted interventions and support mechanisms. Continuous feedback and improvement mechanisms ensure the system's relevance and effectiveness over time. Overall, the proposed system serves as a valuable tool for promoting student success and fostering a supportive learning environment that prioritizes student well-being.

8. References:

- [1] O. Adewuya, B. A. Ola, et O. O. Afolabi, « Validity of the patient health questionnaire (PHQ-9) as a screening tool for depression amongst Nigerian university students », *J Affect Disord*, vol. 96, no 1, p. 89-93, nov. 2006, doi: 10.1016/j.jad.2006.05.021.
- [2] T. W. Wong, Y. Gao, et W. W. S. Tam, « Anxiety among university students during the SARS epidemic in Hong Kong », *Stress and Health*, vol. 23, no 1, p. 31-35, févr. 2007, doi: 10.1002/smi.1116.
- [3] K. Shamsuddin et al., « Correlates of depression, anxiety and stress among Malaysian university students », *Asian J Psychiatr*, vol. 6, no 4, p. 318-323, août 2013, doi: 10.1016/j.ajp.2013.01.014.
- [4] A. Dachew, T. Azale Bisetegn, et R. Berhe Gebremariam, « Prevalence of mental distress and associated factors among undergraduate students of University of Gondar, Northwest Ethiopia: a cross-sectional institutional based study », *PLoS ONE*, vol. 10, no 3, p. e0119464, 2015, doi: 10.1371/journal.pone.0119464.
- [5] Abdeslam, C. Hajar, E. Jalal, et L. Amine, « Mental Health Status Among Moroccan Medical Students at the Cadi Ayyad University », *International Journal of Psychiatry Research*, vol. 2, no 1, 2019, doi: 10.33425/2641-4317.1006.
- [6] Ben Loubir, Z. Serhier, S. Diouny, O. Battas, M. Agoub, et M. Bennani Othmani, « Prevalence of stress in Casablanca medical students: a cross-sectional study », *Pan Afr Med J*, vol. 19, p. 149, 2014, doi: 10.11604/pamj.2014.19.149.4010.
- [7] « JMIR - Computer-Delivered and Web-Based Interventions to Improve Depression, Anxiety, and Psychological Well-Being of University Students: A Systematic Review and Meta-Analysis | Davies | Journal of Medical Internet Research ». <https://www.jmir.org/2014/5/e130/#ref9> (consulté le oct. 09, 2019).
- [8] R. Cooke, B. M. Bewick, M. Barkham, M. Bradley, et K. Audin, « Measuring, monitoring and managing the psychological well-being of first year university students », *British Journal of Guidance & Counselling*, vol. 34, no 4, p. 505-517, nov. 2006, doi: 10.1080/03069880600942624.
- [9] K. Zivin, D. Eisenberg, S. E. Gollust, et E. Golberstein, « Persistence of mental health problems and needs in a college student population », *Journal of Affective Disorders*, vol. 117, no 3, p. 180-185, oct. 2009, doi: 10.1016/j.jad.2009.01.001.
- [10] « PsycNET - DOI Landing page ». <http://psycnet.apa.org/?&fa=main.doiLanding&doi=10.1037/0002-9432.77.4.534> (consulté le avr. 13, 2016).
- [11] « Mental Health Smartphone Apps: Review and Evidence-Based Recommendations for Future Developments. - PubMed - NCBI ». <https://www.ncbi.nlm.nih.gov/pubmed/26932350> (consulté le avr. 17, 2020).
- [12] « Evidence-based practice in psychology. - PubMed - NCBI ». <https://www.ncbi.nlm.nih.gov/pubmed/16719673?dopt=Abstract> (consulté le avr. 17, 2020).
- [13] K. Saoane Thach, « A Qualitative Analysis of User Reviews on Mental Health Apps: Who Used it? for What? and Why? », in *2019 IEEE-RIVF International Conference on Computing and Communication Technologies (RIVF)*, mars 2019, p. 1-4, doi: 10.1109/RIVF.2019.8713726.
- [14] O. Eva et al., « Prevalence of stress among medical students: a comparative study between public and private medical schools in Bangladesh », *BMC Research Notes*, vol. 8, no 1, p. 327, déc. 2015, doi: 10.1186/s13104-015-1295-5.
- [15] A.-G. S. al et, « A longitudinal study of psychological stress among undergraduate dental students at the University of Jordan. - PubMed - NCBI ». <https://www.ncbi.nlm.nih.gov/pubmed/26968682> (consulté le août 31, 2018).
- [16] K. M. Graner et A. T. de A. R. Cerqueira, « [Integrative review: psychological distress among university students and correlated factors] », *Cien Saude Colet*, vol. 24, no 4, p. 1327-1346, avr. 2019, doi: 10.1590/1413-81232018244.09692017.
- [17] R. E. Recabarren, C. Gaillard, M. Guillo, et C. Martin-Soelch, « ShortTerm Effects of a Multidimensional Stress Prevention Program on Quality of Life, Well-Being and Psychological Resources. A Randomized Controlled Trial », *Front Psychiatry*, vol. 10, mars 2019, doi: 10.3389/fpsy.2019.00088.