Insightful Mental Health Tool for Students

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Keywords: Students' Mental Health, Multilayer Perceptron, Artificial Neural Network, Intelligent Data Analysis.

Abstract: This paper aims to understand the nexus between academic context and student well-being. It provides an overview of the prevalence of mental health problems among students and the ways in which these issues can impact academic performance. Nevertheless, the factors of the academic environment that can influence a student's mental health are also discussed, outlining the importance of addressing such issues in the student community and the potential long-term impact it can have on individuals, leading us to the reasoning behind creating the application that serves as the focus of this paper. Considering the practical use of the application and what it offers, this paper will also discuss the intelligent analysis of the collected data, enabling further interpretation by mental health professionals.

1 INTRODUCTION

Living in a world where the professional success of a high school graduate can be predicted by his choice to pursue higher education studies and the career prospect is directly impacted by his academic performance, we were determined to find a way of supporting the students who do not always meet the expectations of either their families or their educators. A student who drops out of school embodies the image of incompetence or disinterest most of the time, but how often have people taken the time to analyze the factors that led to the dropout or the poor academic performance that often precedes it?

A student's academic functioning and, subsequently, career outlook are unfortunately heavily influenced by mental health disorders, given that most factors weighing in on a student's mental health state originate in the academic environment. These factors embody academic expectations and pressure to succeed, meet deadlines, manage time efficiently, or even cover the cost of education.

Mental health is an important aspect of overall well-being, and it can be particularly challenging for students to maintain good mental health due to the many stresses and demands of the academic environment. In recent years, college student populations have witnessed a surge in symptoms of depression, anxiety, and other mental illnesses, accompanied by

a consistent growth in the demand for counseling services (Duffy et al., 2019). College students frequently experience mental health issues, which are clearly connected with lower academic performance. Additional research is required to determine whether this link could be causal and, if so, whether therapies aimed at addressing mental health problems could enhance academic performance.

The college years are a critical developmental stage in which students transition from late adolescence to emerging adulthood (Arnett, 2023). Some of the long-term adverse outcomes (including persistent emotional and physical health problems or relationship dysfunction) may be influenced by mental health issues that arise throughout the college years, as these years are a peak phase for the emergence of a wide spectrum of mental disorders.

According to research conducted by the Romanian National Council for Higher Education Financing in 2018, around 74% of Romanian high school graduates pursued their studies in higher education. A study by the Romanian Ministry of Education revealed that, in the 2019-2020 academic year, the overall dropout rate for Romanian universities was 10.4%, which was a slight decrease from the previous year's rate of 10.5%. Previous research has found that college students with mental disorders or illnesses are twice as likely to drop out without obtaining a degree. There are fewer studies that focus on the association between mental health problems and academic success in college. The majority of data supports the

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conclusion that depression and suicidal thoughts and behaviors are associated with a lower grade point average (De Luca et al., 2016).

In this study we analyze other relevant works from the specialized literature and present the creation of an application for identifying mental problems among students using an intelligent data analysis.

2 THE LITERATURE REVIEW

2.1 Educational Context and Mental Health

The article (Bruffaerts et al., 2018) published in the Journal of Affective Disorders investigates the link between mental health problems and academic performance among first-year college students. It is carried out as part of the World Mental Health Surveys International College Student (WMH-ICS) project and focuses on students at KU Leuven University in Belgium. The primary objective is to identify the impact these issues have on academic performance, as measured by Academic Year Percentage (AYP) and grade point average (GPA).

The study involved a sample of 4,921 first-year students who completed an online mental health survey. Administrative data were used to assess academic achievement at the end of the year as well as demographic information. Mental health problems were assessed using the Global Appraisal of Individual Needs Short Screener (GAIN-SS), a validated instrument for screening emotional and behavioral problems.

Among the main results was that about 34.9% of students reported mental health problems in the past year. The most common problems reported are those of an internalized nature such as depression or anxiety, being present in 23.70% of those who reported problems. Hyperactivity, impulsivity or other types of externalized problems were present in 18.30% of the students. Problems such as substance use or antisocial behavior were less frequent, 5.40% and 0.10% respectively.

The data show that mental health problems have a significant negative impact on academic performance, with students with internalizing and externalizing problems experiencing a 2.9% to 4.7% decrease in AYP, corresponding to a 0.2–0.3 decrease in GPA (Bruffaerts et al., 2018). The effect of externalizing problems was more pronounced in departments with lower overall academic performance. This suggests that lower performing academic environments may amplify the impact of mental health problems on school outcomes.

Of course, there are some limitations regarding the (Bruffaerts et al., 2018) study, such as the small number of cases of students with antisocial behavior within the sample, or the lack of data on academic performance in high school, which could have influenced the observed relationships. Another thing that could have limited the study is the fact that the data are based on a single screening tool and refer to a single university, limiting the generalization of the results. This study indicates the need for interventions at the university level. Supportive mental health interventions could help improve academic performance and reduce the risk of dropping out.

Another work that addresses the connection between mental health and the academic performance of students in the first year of college is (Wyatt et al., 2017). The authors used data from the American College Health Association-National College Health Assessment (ACHA-NCHA) and underline the fact that there is a strong correlation between the mental health of students and the drop in academic performance and the risk of dropping out.

The data set on which the experiments were performed were collected from students in 2011 and consists of 66,159 records. Forms were analyzed regarding problems such as anxiety, depression, self-harm and suicidal ideas and how they affect academic performance in the first year of college. According to the authors the first year of college in the United States brings many changes in the lives of young people, being the period with the highest incidence of mental health problems, with students frequently reporting symptoms of depression and anxiety. Diagnoses increase progressively as students advance through their years of study, and female students are more prone to such problems than their male peers. Depression and anxiety are frequently associated with lower grades, dropping out of classes and, in some cases, dropping out of school.

The study makes certain recommendations for the university, such as the inclusion of emotional education classes and stress management techniques or improving access through various methods (eg online communication). The conclusions of the (Wyatt et al., 2017) study show that promoting awareness and early interventions in mental health is essential both in the first year of college and throughout the years.

A very useful study focused on the problem of mental health and the relationship between it and academic performance is the paper (Zhang et al., 2024). The authors of the study emphasize stress, depression and anxiety in the post-pandemic period and their in-

fluence on students. The sample used in the study contains 600 students divided into two categories (300 first year students and 300 fifth year students). The DASS (Depression, Anxiety, and Stress Scale) and PHQ-9 (Patient Health Questionnaire-9) scales were used to measure mental health, and academic performance was assessed on a 12-point scale.

The obtained results showed that the first-year students have a higher level of stress (27.1 compared to 24.2 for the 5th year), but they obtained higher average academic scores (11.2 compared to 10.5). The results indicate a negative correlation between stress and academic performance ($r = -0.25$). Another impressive result is that anxiety and depression were observed to have a significant influence on academic performance (depression: $r = -0.20$; anxiety: $r = -0.18$). The reduction in symptoms led to an improvement in academic performance. The (Zhang et al., 2024) study highlights the fact that students reported a significant impact of the pandemic on mental health, with persistent symptoms of social isolation and changes in the learning process. About 75% of students reported difficulty adjusting to online learning, and 30% reported long-lasting physical symptoms after being infected with COVID-19. The study highlights the need for preventive measures for students' mental health and shows that supportive interventions can help improve academic performance and overall well-being.

2.2 Machine Learning in Students' Mental Health

Considering the importance of mental health in the lives of students and beyond, it goes without saying that there are numerous studies that investigate these correlations using machine learning and artificial intelligence techniques. Paper (Shafiee and Mutalib, 2020) presents the rise of mental health problems among Malaysian higher education students as part of a global phenomenon. These problems seriously affect the daily life of students and their social interactions, negatively influencing their academic performance and their integration into the university environment. In Malaysia, the Ministry of Higher Education supports approximately 20 public institutions and 447 private institutions, which educate over 550,000 students annually. In this context, students face major pressures such as separation from family, financial insecurity and uncertainties about their future careers, all of which contribute to a high risk for mental health problems. The study found that many students avoid seeking help because of stigma or the belief that these problems are normal in university life.

Among the types of mental health problems that have been investigated are anxiety disorders, depressive disorders and contributing factors. In the study (Shafiee and Mutalib, 2020), several algorithms were used for the analysis of mental health data, such as Support Vector Machine and Neural Networks for the classification and analysis of psychometric responses, and for the predictions related to the emotional and mental states of the students, Random Forest and Logistic Regression were used.

The authors suggest that machine learning techniques can play a crucial role in identifying and monitoring mental health among students, helping to detect risks early and providing universities with guidance for developing personalized support programs. In this study, the authors obtained notable results regarding the ability of machine learning models to predict students' mental health problems. SVM (Support Vector Machine) and Neural Network models have demonstrated high accuracy with accuracy rates over 70%-96%, outperforming other methods in analyzing anxiety and depression data. These models have proven effective in differentiating complex mental states and have shown that factors such as lack of social support and academic stress are the most predictive of students' mental health.

The authors of the (Baba and Bunji, 2023) article explore the application of a machine learning model to identify mental health problems among college students using data from annually collected health questionnaires. The study was conducted on a sample of 3.561 students at a university in Japan, with responses including demographic variables, questions about university life, and response time data. The main aim of the study was to develop a prediction model for identifying the risk of mental health problems, both within one year and in the following year, based on students' responses to health questionnaires. The model was based on machine learning algorithms, including LightGBM (Gradient Boosting Machine), which was compared with other models, such as logistic regression and Random Forest. The chosen model, LightGBM, demonstrated superior performance as assessed by performance indicators such as the Matthews Correlation Coefficient (MCC), showing a high ability to predict mental health problems.

Comparing various models, LightGBM was the best performer in the study (Baba and Bunji, 2023), especially in analyzing current year predictions and anticipating problems for the next year. Answers to questions about difficulties in university life (eg, anxiety about the future) were among the strongest predictors, with a high impact (gain of 0.131 - 0.216 and SHAP values of 0.018 - 0.028). Variables related to

response time, although considered relevant, did not significantly improve the performance of the model.

The authors of (Madububambachu et al., 2024) study carry out a systematic analysis of machine learning techniques applied in the diagnosis of mental health disorders, with an emphasis on university students. The study includes 30 papers published between 2011 and 2024 that explore Convolutional Neural Networks, Support Vector Machine, Random Forest and deep neural networks algorithms for diagnosing conditions such as depression, anxiety, PTSD, ADHD and schizophrenia. The study applies a PRISMA methodology to collect and analyze relevant articles. Inclusion criteria were based on keywords such as "deep learning" and "predict mental health," searching for relevant papers in recognized databases, including IEEE Xplore and ScienceDirect. The analyzed data comes from various sources, such as fMRI images, EEG signals, text data from social media and medical surveys.

The study stands out for obtaining satisfactory performances. The CNN and Random Forest models performed highly, with up to 99% accuracy, in diagnosing depression and anxiety. Social media text and EEG analysis have proven to be effective tools for prediction. The application of CNN and RF algorithms on GPS and EEG data achieved an accuracy of 80%-99%, depending on the specifics of the dataset, and the SVM algorithm demonstrated high efficiency in detecting brain structural changes through imaging data, reaching AUC (Area under the ROC Curve) of up to 0.93.

The authors conclude the paper (Madububambachu et al., 2024) that although machine learning models show promise for diagnosing mental disorders, there are important limitations, such as limited access to large datasets and the interpretability of complex models such as neural networks. The study suggests that standardization and the use of more diverse and longitudinal data sets could improve the accuracy of diagnoses and the ease of implementing these models in clinical practice.

The article (Rahman and Kohli, 2024) explores the mental health issues facing international students, using machine learning techniques to analyze the demographic, cultural and psychosocial factors that influence this category. The main aim was to create a predictive model based on machine learning that could identify the risk of depression among international students in the UK. This approach is motivated by increasing cases of depression and anxiety among international students, often associated with academic stress, financial difficulties, culture shock and other adjustment problems.

The research was based on two unique data sets, the first obtained through a survey applied to a group of 87 international students between February and March 2023 used for the training part of the model, and the second used for testing contains data from 201 international students and was used to train and test depression prediction models. The second set is known as *A Dataset of Students' Mental Health and Help-Seeking Behaviors in a Multicultural Environment*. In the study (Rahman and Kohli, 2024), four machine learning algorithms were used: *Logistic Regression, Decision Tree, Random Forest* and *K-Nearest Neighbors*. The performance evaluation of each model was done by accuracy, sensitivity, specificity, precision, and AU-ROC curve metrics.

The results obtained emphasize the importance of specific demographic and psychosocial factors in the prediction of depression. The main contributors to international students' mental health problems were found to include financial difficulties, academic stress, homesickness, isolation, and culture shock. Specifically, students in the 21-25 and 26-30 age categories, women and singles are more prone to depression and anxiety. The results also show that students who have little social support or feel excluded from the community have a higher risk of mental health problems. In terms of algorithm efficiency, the Random Forest model had the highest accuracy of 80%, demonstrating a better ability to identify depressed students. It had a high specificity in correctly identifying cases without depression, but a lower sensitivity in identifying positive cases, suggesting a stronger performance in confirming mental well-being than in detecting the risk of depression. Although the results obtained in (Rahman and Kohli, 2024) are very good, a major limitation of the study is the relatively small size of the samples, both of the primary and secondary sets.

A paper aiming to detect and predict mental health disorders among students by applying various machine learning techniques is (Sahu and Debbarma, 2022). The authors tested the performance of the algorithms: Logistic regression, decision trees, random forest, closest neighbors k, and neural network to predict the risk of mental disorders among young people. In the study a data set with 5,840 records was used. To evaluate the models the authors used the confusion matrix and calculated the accuracy, precision, sensitivity and AUC-ROC. The Neural Network model demonstrated the highest accuracy of 99.03%, being the best performer in predicting the risk of mental disorders in students. The random forest and K-nearest neighbor algorithms also scored highly, suggesting their effectiveness in mental health assess-

ment. The Neural Network model had an AUC score of 0.98, indicating excellent performance in identifying differences between positive and negative cases of mental disorder risk. This article (Sahu and Debbarma, 2022) contributes to the literature by providing an automated and integrated solution to predict student mental health using machine learning algorithms in a way that is accessible to educational institutions.

3 MENTAL HEALTH CHECKER FOR STUDENTS

As part of this research, we have created a practical application that aims to check the mental health of female students. **Mental Health Checker for Students** is a web application whose usability and functionality revolve around a mental health quiz that analyzes how the academic environment can impact students' daily activities. Through our research and application of our field-related knowledge, we have created a powerful tool for educators and mental health professionals to better understand and support students in achieving their full potential.

3.1 Concept

The concept of the application is that the student can use the safety of anonymity to expose his vulnerabilities related to the academic context. Given this, the features responsible for user management were built so that the completion of the quiz is in no way dependent on or related to registration within the application. When entering the web site, the user is welcomed with the landing page of the application, and it gives the user the possibility to be redirected to all the available resources within the app, either by using the navigation bar or from the slideshow containing a presentation of the functionalities.

Through the completion of the quiz by users, the aim of investigating the extent to which mental health problems are associated with academic functioning can be met. Additionally, the application provides detailed analytics on user activity, including quiz completion rates, quiz scores, and user engagement, allowing users to track their progress in improving their mental health state and subscribe to a newsletter that provides regular self-care tips via mail. With personalized user profiles, individuals can view their most recent quiz score, update subscription preferences or personal information, and monitor their progress over time. Moreover, the administrator user role is available for managing user accounts and newsletter distribution, with the admin being able to send the user

the weekly or monthly newsletter (depending on the user's preference) or delete the user's account.

3.2 Process of Creating the Quiz

When preparing the dataset for creating the mental health quiz for the web application, several important considerations were taken into account, such as legitimate research, the topics' diversity, reliability, and adaptability. The questions included in the mental health quiz were carefully curated based on established research and with the help of a professional, a certified psychologist with over 15 years of work experience. This ensures the validity and reliability of the quiz in measuring relevant aspects of mental health within the academic context. The questions cover a wide variety of topics related to mental health, including stress, anxiety, depression, time management, coping mechanisms, and social support. By including a diverse set of topics, the quiz aims to provide a thorough assessment of a student's mental well-being within the academic environment. The dataset was created with adaptability and scalability in mind. It can be easily modified or expanded to accommodate future updates, improvements, or customization based on feedback or emerging research in the field of mental health. Regarding the sensitivity of the questions and the privacy of the users taking the quiz, steps were taken to ensure that the questions were respectful and non-intrusive, and along with the option of taking the quiz without registration, the confidentiality and anonymity of the participants were protected.

3.3 Questions Dataset

The quiz consists of the following questions:

- About how often did academic activities (courses, laboratories, exams) make you feel stressed (tense, irritable)?

- About how often did you feel that your effectiveness in learning is affected by the pressure that is placed on you?

- About how often was your sleep schedule affected by stress during a year of study that involves attending classes and laboratories?

- About how often have you struggled with anxiety when you had to present your work in front of your peers or teachers?

- About how often did you fail to meet the deadlines for handing in assignments?

- About how often do you think you have not been able to maintain a healthy relationship with your family because of the academic environment?

- About how often did you regret your choice to attend college?

- About how often did you have a positive attitude when encouraging others to attend college?

- About how often did you feel that everything was an effort?

- About how often did you feel panicked or overwhelmed by things in your life?

Regarding responses, the quiz's answer scheme includes the following choices:

- None of the time

- A little of the time

- Some of the time

- Most of the time

- All of the time

The five gradations offer a range of options that cover a spectrum from no occurrence to a complete occurrence, creating a 4-scale questionnaire and providing a detailed framework for assessing the impact of the academic context on various aspects of mental health. Given that this scheme is flexible and adaptable to different scenarios or contexts within the academic environment, it can also be easily modified or expanded upon to accommodate specific needs or changes in the field.

3.4 Intelligent Data Analysis

For an intelligent analysis of the data gathered with the help of the application, and more specifically, in order to obtain a prediction for the next score on the mental health quiz, we used the multilayer perceptron classifier model to manipulate the data extracted from the StatisticalEntry table from the database, which contains information about every quiz completion until the present. The training data (the data extracted from the StatisticalEntry table) is propagated to the MLP through the input layers, then passes through the hidden layers. Next, by applying the activation function (in this specific case, the Rectified Linear Unit function), the output is generated at the output layer. The predicted output will then be compared to the actual output; hence error will be calculated. Based on the test dataset, we were able to make a prediction regarding the evaluation of the next possible score on the quiz. The model accuracy, precision, recall, and F1 score, also known as the harmonic mean of the

precision and recall, were also assessed. This example of intelligent data analysis that performs predictions can be a way to facilitate the interpretation or further development of the data generated within the application by mental health specialists.

Table 1: Statistical Metrics.

Performance Metric	value
Accuracy	0.83
Precision	0.83
Reacll	1.00
F1 Score	0.91

The results obtained are very satisfactory and shows that machine learning algorithms can be successfully used in the early prediction of possible mental problems of students. The results can be viewed in Table 1.

4 CONCLUSIONS

Mental health is one of the most precious things we have. Daily stress and problems in everyday life can lead to serious mental health problems, conditions such as depression, anxiety and suicidal thoughts are more and more common among people, especially among young people. The vast majority of young people who face such problems are students, and their early detection could lead to efficient and quick treatment.

Given that the application's main focus is the mental health quiz designed for students, further development or use of the Mental Health Checker can include creating several quizzes targeting different aspects of mental health. Providing users with multiple self-assessment tests can be an additional step towards identifying struggles and getting the right help. In terms of adding more functionalities to the application, an online forum can also be created as a safe place for students to express their thoughts and concerns, with the possibility of receiving direct support from a professional. This would also include creating a new user role or assuming that behind the Administrator role is a certified psychologist. Moreover, as we discussed in the previous chapter, the intelligent analysis of the collected data can be taken to an extent where specialists in the mental health field interpret it, taking into account the relevant improvements that can be made as a result of the analysis. At the same time, we could apply other intelligent algorithms regarding the prediction of the next score on the mental health quiz.

Mental Health Checker is addressed specifically to students and it It provides a self-assessment process for identifying mental health struggles, more important It offers quick links and contact options to counselors, professionals, or emergency lines.

We are aware of the limitations of this study, but we consider it a good starting point for other research in the field of students' mental health.

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