Student mental health and academics

Aditya Ranganayakula

Abstract – Mental health issues significantly impact our mood, thinking, and behavior, making it crucial not to overlook their implications, particularly among students. This project focuses on developing an interactive visualization using Tableau to explore student mental health dataset from Kaggle. The primary objective is to investigate the prevalence of mental health issues-such as anxiety, depression, and panic attacks-across various academic years, courses and to evaluate if there is any impact of these issues on student's academic performance. This visualization offers insights on the areas where students may require medical help, advocating for stakeholders to offer expert help, ultimately contributing to a conducive and supportive learning environment.

Keywords – Anxiety, Depression, Panic Attacks, Interactive visualization, student mental health.

1 Introduction

The significance of mental health in educational environments has been increasingly acknowledged in recent times. Student well-being is crucial not only for personal development but also for academic achievement. Mental health disorders, such as anxiety, depression, and panic disorders, can profoundly affect a student's mood, thought process, and behavior, potentially impending their well-being and academic progress as well.

Recognizing the critical need to address these challenges, this project centers on an interactive visualization that explores student mental health dataset obtained from Kaggle. By visualizing this dataset, we strive to reveal patterns and insights that illuminate the prevalence of mental health problems across various aspects. The tool used for this purpose is Tableau.

The main goals of this visualization are to comprehend how mental health issues fluctuate across different academic years and courses. By exploring the intersections of mental health and academic performance, we seek to identify potential correlations and trends that can inform stakeholders and institutions about the areas where intervention and support may be more effective.

This project goes beyond mere representation of data; it prompts the stakeholder (educational institutions) to identify the areas where professional help is most required. The ultimate aim is to aid in the contribution of a conducive and supportive learning environment that not only fosters academic growth but also promotes the mental well-being of students.

As we go through this paper, we look into a detailed exploration of student mental health, tracing the iterative design process across project phases, and witnessing the evolution of the final functional prototype of this interactive visualization.

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2 Literature Review

The relationship between student mental health and academic performance has been a subject of extensive research, encapsulating a wide array of disciplines and methodologies. Patel et al. (2007) underscores the significant influence of mental disorders that begin in youth, emphasizing their correlation with lower educational achievements and other developmental concerns [4].

Furthermore, a study focusing on anxiety symptoms among undergraduate students, using the GAD-7 questionnaire, elucidates the intricate relationship between various mental health symptoms and academic outcomes. This study is pivotal in highlighting the multifaceted nature of mental health challenges and their diverse impacts on educational performance, considering a broad spectrum of demographic and socio-economic factors [5]. Also, multiple visualizations on this dataset are available on Kaggle and Tableau with each focusing on a unique objective.

In addition to the academic insights, non-academic sources offer a practical perspective on the issue. An article from Independent School Management provides valuable insights into the real-world implications of mental health challenges within educational settings. This article explores how conditions such as depression and anxiety manifest in academic environments, impacting student motivation, concentration, and, consequently, their overall performance. It serves as a critical link between academic theory and the practical realities on the ground, underscoring the vital role of educators in recognizing and addressing students' mental health needs [6].

The objective of this project aligns with this practical perspective, as it seeks to convey the importance of mental health support within an educational institution through an interactive visualization.

3 Data

The dataset used in this research is obtained from Kaggle [3]. This data set was collected by a survey conducted by Google forms from university students in order to examine their current academic situation and mental health [3].

The dataset comprises 102 entries organized into 11 columns. These columns cover various aspects, including timestamp, age, gender, the student's year of study, marital status, CGPA (ranging from 0 to 4),

course of study, and indicators for mental health issues such as depression, anxiety, panic attacks. Additionally, a column indicates whether participants sought any medical help.

Each row in the dataset corresponds to an individual student who participated in the survey. Numerical data is present in columns such as age, CGPA, and year of study, while columns related to mental health issues utilize binary values, with “yes” indicating the presence of the issue and “no” signifying its absence. Some attributes like year of study and age almost follow same pattern. Therefore, only “year of study” attribute is used.

Several elements within the dataset underwent modifications prior to its utilization in Tableau. One notable example of such modification involved the correction of course names, such as "Engineering." Since Tableau is case-sensitive, it could interpret variations in the spelling of course names as distinct entities. Thus, these modifications aimed to ensure consistency and accuracy in the dataset's representation within the Tableau environment.

Additionally, one more column “program” is added to this dataset. All the courses are clustered into programs, and this attribute is used for the bar graphs in the second dashboard. A detailed explanation of this addition will be explained in Section 5 of this paper.

4 Tasks

The tasks of this visualization are to investigate the distribution of “anxiety”, “panic attacks” and “depression” across various years of study, program and to check if they affect student’s academic performance.

4.1 Mental health issues and Year of study:

The “year of study” is categorized into four distinct years: freshman, sophomore, junior, and senior. The objective is to analyze the distribution of the three mental health issues of interest among students across these various years.

4.2 Mental health issues and Program:

All the courses in the dataset are clustered into various academic programs, including Accounting, Biosciences, Engineering, Environmental Studies, Islamic Education, Law, and Medicine. The objective is to examine the variations in the prevalence of the three identified mental health issues among students in different programs of study.

4.3 Mental health issues and CGPA:

Many research studies highlighted in the literature review section underscore the impact of poor mental health on student’s academic performance. The goal of this project is to explore whether a correlation exists between these two attributes and to identify any intriguing patterns that may emerge.

5 Design Iterations & Rationale

The project followed an iterative approach, with each iteration addressing the shortcomings identified in the preceding iteration.

This section provides a comprehensive discussion of all the phases involved in the project process.

5.1 Hand-Drawn Sketches:

The first stage of this project was visualizing the ideas through conceptual drawings i.e., hand-drawn sketches. These sketches serve as the foundation for subsequent iterations. Three sketches are designed that suggest choice of encodings and type of charts that try to convey the goals of visualization.

Sketch-1 is a tree map that illustrates the distribution of students facing mental health issues across different courses. The tooltip feature provides additional information for each course. In Sketch-2, a bubble plot is employed to examine the correlation between academic performance (CGPA groups) and the number of students, offering insights into potential patterns. Sketch-3 serves as an alternative to Sketch-1, presenting the same information using a stacked bar graph, incorporating additional attributes for a more comprehensive view.

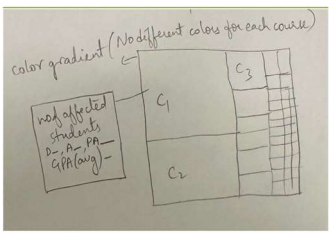

Fig.1. Sketch-1

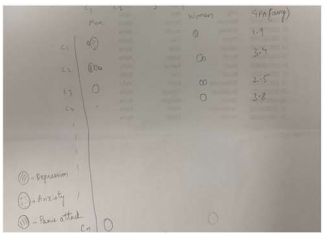

Fig.2. Sketch-2

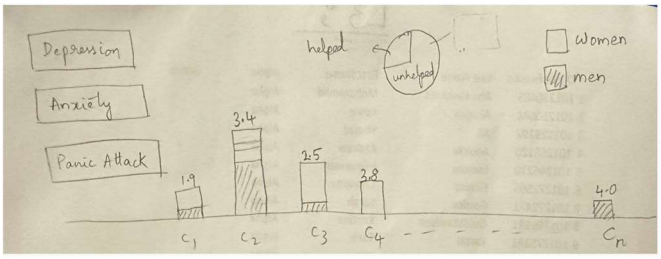

Fig.3. Sketch_3

5.2 First iteration:

In this stage, I began implementing the previously mentioned sketches in Tableau. However, only selected sketches are incorporated from all the three hand-drawn sketches. For instance, only pie chart from Sketch-3 is utilized. Figure 4 shows the first iteration on Tableau. The first iteration utilizes only three plots within a single dashboard.

Fig.4. Iteration1

In the bubble plot, the size and position of each bubble convey the number of cases of each mental health issue. Each bubble is

positioned within a CGPA group column, indicating the category of CGPA that the students in the bubble belong to.

In the tree map, the area encoding visually represents the number of students who are experiencing at least one issue within a particular course. It is evident that challenging and competitive courses such as Engineering and BCS have a higher number of students who are experiencing at least one issue.

The pie chart illustrates the percentage of students who sought medical help. Pie chart is chosen because the entities in this attribute are binary “yes” and “no” values. Depicting the percentage of students in a pie chart is much effective since there are only two categories.

5.3 Second iteration

After the first iteration, it became evident that leveraging additional attributes was crucial for a more insightful analysis of the dataset. Consequently, I created visualizations depicting the relationships between “year of study" and “marital status” with mental health issues. The insights gained from this visualization will be thoroughly discussed in Section 5.3.1. Also, multiple interactions such as “filter”, “highlight” are added and the labels in tooltips were refined, addressing issues identified in the first iteration. Furthermore, I conducted a user study to assess the effectiveness of visualization. The design in the second iteration is shown in Figure 5.

5.3.1 Year of Study vs Mental health problems:

All three mental health issues are plotted against “Year of study” in a stacked bar graph where each section in a bar is color-coded in CGPA group. A monochromatic color gradient was used for CGPA encoding as it is sequential data. The idea is that, the size of bar can quickly facilitate assessment of the number of cases across different years.

5.3.2 Marital Status vs Mental health issues:

Just as CGPA was plotted against three issues, marital status was also plotted to uncover any intriguing patterns or valuable insights that might surface. Same plot was used except a pie chart is used instead of bubble.

5.3.3 After user study:

A couple of changes were made after conducting user study. Borders were added to each section in the stacked bar graph for clear distinction and CGPA groups were added in the tree map.

Fig.5. Second iteration – Added filters and stacked bar graph.

5.4 Final iteration:

A lot of changes have been made to the final iteration [7], and they are comprehensively discussed below.

5.4.1 Color changes:

The color in the bubble plot in figure 5 is removed as it was deemed unnecessary and potentially confusing for users, as it could be mistaken for representing similar elements in the graph. So only position and size encodings have been retained for the bubbles in the final iteration.

5.4.2 Marital status graph removed:

This graph is removed in the final iteration as it did not convey any necessary information to the stakeholders.

5.4.3 Courses clustered into programs:

There are 20 different courses in the course attribute and there are an uneven number of students for each course. So, I clustered them into 6 programs and calculated the percentage of students suffering from each course. This allows for fair comparison of the number of cases in each disease between different programs. A simple bar graph has been employed for this purpose and each course is encoded in a different color. Given the relatively small number of programs (6 in total), the use of distinct colors is not expected to be overly confusing for users.

5.4.4 Two dashboards in a story:

As we can see in figure 5, having all the graphs in a single dashboard resulted in excessive clutter and failed to effectively communicate the objectives of visualization. Hence two dashboards were used, and their details are discussed in the next section.

6 Evaluation Study and Results

As described in Section 5.3, a user study was conducted to assess the effectiveness of the visualization. The study involved two participants, one with no prior experience in data visualization and the other with basic knowledge in visualization concepts.

6.1 Procedure:

Both participants were provided with a consent form, which they signed before taking part in the study. The study was conducted via a Zoom call, where participants were given access to interact with the visualization prototype. The session began with an introduction to the project, followed by a two-minute trial period for them to explore the visualization. Subsequently, participants were asked a series of questions, including:

1. What is the primary goal of the visualization?

2. What information does the bubble plot convey?

3. What insights can be derived from the tree map?

4. Are the interactive features user-friendly and self-explanatory?

5. Do you have any feedback or suggestions for improvements?

6.2 Results:

Client 1, who had no prior experience in data visualization, recommended the use of distinct colors in the stacked bar graph.

They found it challenging to differentiate between categories in the monochromatic color gradient. They also found the bubble plot time taking to infer, but once understood, they acknowledged it effectively conveys the goals of visualization.

Client 2, who had knowledge about visualizations, suggested the inclusion of borders around sectors within the stacked bar graph. They also raised questions about the choice of a tree map, as it is typically used for hierarchical structures, and in this case, there was no clear hierarchy to represent.

After getting feedback from user study, multiple brainstorming sessions and valuable insights from the professor, I have finally made changes that have led to the current version of the prototype.

7 Dashboard Descriptions

The working prototype [7] of this visualization contains two dashboards.

7.1 Dashboard 1:

This dashboard features a stacked bar graph displaying the distribution of cases across different years of study. Users have the option to interact. Also, the text on the first dashboard conveys the message of the stacked bar chart.

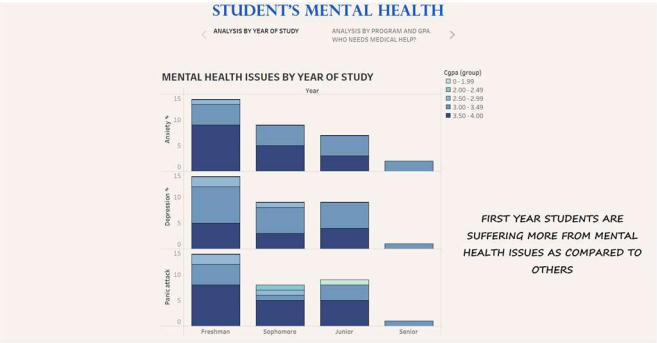

Fig.6. Final Iteration: Dashboard 1 – Analysis by Year of Study

As we can observe in figure 6, it is evident that first-year students experience a higher prevalence of mental health problems compared to other academic years. This observation is reasonable, as first-year students often face increased pressure and adjustment challenges, which may contribute to their mental health concerns.

7.2 Dashboard 2:

Overview: The second dashboard consists various graphs, including:

1. A bubble plot illustrating the correlation between mental health problems and CGPA.
2. Three bar graphs dedicated to anxiety, depression, and panic attacks, providing a breakdown of the percentage of students experiencing each problem by program of study.
3. A donut chart presenting the percentage of students who sought professional help for their issues.

By examining the bubble plot in figure 7, it is evident that larger bubbles are predominantly present in the high CGPA groups, such as 3.0-3.49 and 3.50-4.00, for all three mental health issues.

This indicates that students' academic performance may not be significantly affected by mental health issues. Instead, it appears that high-achieving students are experiencing these issues, which might seem counterintuitive. However, it is conceivable that the pressure to meet academic standards and the competitive nature of education could be taking a toll on students' mental health.

Upon examination of the three bar graphs, it becomes apparent that fields of study such as medicine and engineering exhibit a higher percentage of students encountering issues like anxiety, panic attacks, and depression. This observation aligns with the understanding that these programs are known for their competitiveness and demanding nature.

From the donut chart, it is clear from the chart that the majority of the students did not seek professional help.

Features: In the donut chart, a filter interaction has been incorporated. As depicted in Figure 7, a prompt invites the user to click on the green sector. Upon doing so, all other plots in the dashboard dynamically adjust, offering insights into the students who sought medical help, including their GPA category and program of study.

Also, a marital status filter is included, which dynamically modifies the bubble and bar plots. Although this addition may unveil valuable insights, it's important to note that stakeholders have limited influence over marital status, making it a less actionable variable.

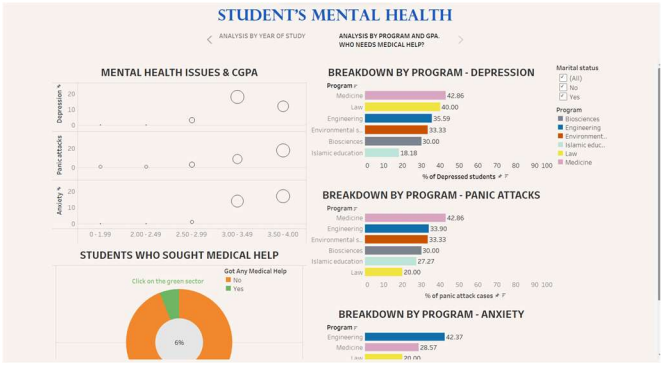

Fig.7. Final Iteration: Analysis by program and GPA and who needs medical help.

8 Discussion and Future Work

In the discussion section, let's navigate through the visualization and derive insights from it.

As previously discussed, the first dashboard reveals that freshman students tend to experience more mental health issues compared to their junior and senior counterparts. Upon selecting the legend for the stacked bar graph, the corresponding CGPA sectors within the bars are highlighted, indicating that a significant proportion of students with high academic rankings face these challenges.

Transitioning to the second dashboard, the bubble plot supports the assumption that high-achieving students are indeed susceptible to these mental health issues. While these issues may stem from various factors, including personal life and environmental influences, academic pressure appears to be a contributing factor. This is evident when examining the bar graphs, where students in competitive

courses exhibit a higher prevalence of these issues compared to students in other programs.

Now, when we take a closer look at the bar graph for depression, we see that more students from “Law” program are suffering from this issue. One plausible explanation for this may be that law students grapple with moral and ethical dilemmas that they encounter in their case studies and course discussions, which may be taking a toll on their mental health.

Also, when we click on the green sector of the donut chart, we can identify the programs to which students seeking medical help belong. Notably, all the students seeking assistance are enrolled in the "Medicine" program. This aligns with expectations, as medical students are generally more aware of the importance of addressing mental health issues. In contrast, students from other programs may not possess the same level of awareness. Therefore, stakeholders have an opportunity to organize awareness campaigns, educate students across various courses, and offer professional assistance to those in need, ultimately fostering a more supportive and proactive learning environment.

For future research, there are several possibilities that could deepen the study and increase its influence. To begin with, broadening the dataset to include a more varied demographic and a larger selection of educational institutions might offer a more comprehensive view of mental health problems. Next, conducting longitudinal studies would allow for tracking student mental health changes over time.

Furthermore, incorporating qualitative data, such as interviews or focus groups, could provide a more in-depth understanding of students’ personal experiences. Other potential areas of exploration include improving visualization interactivity, encouraging interdisciplinary collaborations, creating predictive models for early intervention. These are all promising directions for further investigation in this domain.

9 CONCLUSION

This paper's exploration of student mental health through iterative design stages in data visualization has successfully demonstrated the power of visualization in understanding complex issues. By employing a methodical approach in the visualization of the Kaggle dataset, we have highlighted the intricate relationships between various mental health issues and academic performance. This iterative process has ensured that the visualizations were tailored to effectively communicate the critical findings to the stakeholders.

The user study played a crucial role in refining these visualizations. From initial drafts to the final design, the visualizations were continuously assessed for their ability to present data effectively.

In summary, the application of iterative design stages underscores the importance of effective data visualization in educational research. The final visualizations serve as not only analytical tools but also compelling narratives that shed light on the pressing concerns of student mental health. By effectively conveying these insights, this paper aims to foster deeper understanding among stakeholders, facilitating informed decision-making and targeted interventions in academic settings.

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