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A Multifaceted Machine Learning-Based Approach for Holistic Student Well Being and Academic Success in Sri Lankan Schools

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Abstract **- This research project aims to advance educational outcomes by integrating three key components: predictive modeling for academic performance, social network analysis, and early detection of mental health issues among students including adverse mental health, among learners. The machine learning approaches of the project will create statistical models to predict performance of students and evaluating them for poor performers. Using graph analytic techniques, it will also investigate influence and coordination in the student social networks to understand the effects of social interactions on attitude and behavior toward academics. Furthermore, the study will employ sophisticated multiple telemetry sentiment and emotion analysis tools to identify symptoms of emerging mental health illnesses among the students studying in grade 6 to 9. The goal of this multifaceted method which involves data acquisition from the academic records, social communication level, and effective expressions is to empower educators along with the mental health professionals with effective tools for intervention. The goal is to have an effective learning environment that corresponds to students' needs and expectations and in which they can improve their academic achievements as well as their psychological well-being.**

Keywords: predictive models, academic achievement, social networks, peer pressure, collaboration patterns, mental health status, multimodel data analysis and machine learning, student welfare, learning effectiveness.

I. INTRODUCTION

As education becomes more complicated now, advanced approaches for the analysis have emerged to be crucial for increasing the performance of the students together with their health. Our research project, "A Multifaceted Machine Learning-Based Approach for Holistic Student Well-Being and Academic Success in Sri Lankan Schools," proposes a comprehensive model addressing three key areas: forecasting the academic success, studying students interrelations and cooperation, finding out behavioral tendencies in order to detect possible mental health problems. In the mobile setting we are advancing both android and IOs based applications so as to offer real-time analysis as well as intercessions. This particular project will theoretically seek to improve the academic performance of students besides the academic and socio-emotional wellbeing of students throughout schools in Sri Lanka, to generalise a better learning climate among students.

Data mining in education has receive much attention as a way of early warning system to determine the students who are likely to perform poorly in their studies in order to give them individualized support. Within the scope of this component of our study, we are going to use data mining techniques in order to predict academic performance using various factors such as students' records, attendance, and habits, as well as their demographic characteristics. This is to ensure that the models generated not only provide score estimates for students but also details on intervention strategies. Achievement can thus be attributed to multiple factors that may be mutually reinforcing or pulling in different directions. Consequently, the study's analytical approach comprises data gathering, pre-processing, modeling, assessment, and implementation strategies. Combining different information sources we can form a complete picture of the academic performance of each learner. The use of the predictive models will result in identification of students who require support earlier, before they get lost, such that interventions like tutoring, counseling, changes in approach can be instituted. Its actualization seeks to rectify the lapse in timely, accurate, relevant, and effective application of interventions in improving educational outcomes.

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Students are in school all day and interact with their classmates and teachers, which makes social relationships an essential factor influencing students' academic beliefs and conduct. The method of this research component is the social network analysis which investigates role of peer relations and cooperation in learning achievements. To achieve these goals, we will leverage some of the state-of-art machine learning methods for graph data including graph neural networks with the attention mechanism to analyse the graph of relations among students as well as the flows of information and behaviours within these graphs. The research will investigate several critical aspects of student social networks: the roles and processes of peers, the generalised processes of cooperation and specific factors motivating cooperation. Insights into these dynamism may help in gaining an understanding of how social relations relate to academic achievements or difficulties. For instance, we will assess how study-related perceive beliefs and study-related behavior in interactions processes, as well as how collaborative endeavours influence achievement. The main conclusions will be used in the process of elaboration of the required interventions aimed at promoting positive peer relationships and ensuring successful students' interaction. The source of data for the analysis for the students will be collected through surveys, social media and academic records and the data will be visualized in the graphs where nodes represent the students and the edges representing their interaction. By employing highly developed graph-based techniques we would like to reveal such patterns that will help educators gain insights into creating collaborative, supportive learning environment of a classroom.

Psychology can be assumed to be a crucial component of students' overall health that affects learning outcomes as well as personal relations. This part of our study is centred on exploring early identification of mental health disorders by employing novel multi-modal sentiment-emotion analysis methods. Diagnosing earlier signs of mental health issues is often carried out through subjective measures like reporting or observing symptoms that might show a progressive change. We employ deep learning architectures to interpret textual, auditory, and video data regarding students' demeanor and accordingly, the emotions they experience. The viable group that the project aims to reach out to comprises of students in grades 6 to 9 and which is a crucial developmental stage concerning their emotional and psychological well being. They claim that by studying written work, profiling behavior in a classroom, and observing changes in facial expressions, there should be a possibility to find indications of a patient's mental disorder. This will help to identify such challenges early enough so as to try and counter them with an aim of reducing the extent of their effects on the children's performances. In order to prevent over-fitting, we will incorporate multi-task learning alongside transfer learning to train datasets that are stable across student types and institutions. This multi-disciplinary perspective merges personality and social psychology, education, and computer science useful since it provides such a framework.

II. LITERATURE REVIEW

The application of prediction, social network, and behavioral analysis for students is a synergy of different disciplines since prediction and social network analytics belong to a completely different context as behavioral analysis does, so all of these together provide invaluable input for educational outcomes. To that end, this literature survey focuses on the current and historical research supporting the following three elements: These three elements are identified and the findings of the relevant research studies, some research methods used and the practical application of these components in education are reviewed.

The discussion of early identification of mental health concerns in the learners within education contexts also reveal more concern for such issues and the growing approaches in recognizing their developments. Cross-sectional investigations clearly demonstrate that a two to nine percent of adolescents meet the criteria for suffering from mental health disorders and, thus, mandate coping approaches for early diagnosis and intervention [1]. The initial methods of detection that include teachers' observations and self-Reporting have proved useless but have been the bedrock on which most current techniques are based; their main weakness is that they are not permanent and rely on previous symptoms [2]. New ways driven by technology such as Artificial Intelligence as well as Machine Learning are likely to yield big returns in the fight against early detection. Combining the work done in textual, auditory, and visual approaches for sentiment and emotion analysis, multi-modal sentiment and emotion analysis work as a novel concept to capture dynamic changes in adolescents' emotional status. CRY diced into smaller portions have been found to be useful in remodelling the shape of the hair follicle as well as increasing its outer root sheath layer thickness [3]. These techniques help to design deep learning systems, which are able to work on data from different modalities simultaneously, that may provide the deeper insights about students' well-being. The use of technology in educational settings has started receiving mileage, and it has been implemented on digital platforms which are used mainly for screening and monitoring of mental health among individuals [4]. Yet, the imperative ethical and practical fall- out of putting in place such systems should not be forgotten. Matters of data protection and collection, data approval, and participant engagement best practices remain vital for reflection. Responsible usage of technology for the intervention of mental health [5]. Furthermore, the ability to detect Ear biases

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and the applicability of detection models to different populations and situations are critical factors. Studies have been conducted to gauge transfer learning approaches as well as model adaptation methodologies. Enhance the efficiency and stability of identifying patients with mental disorder [6]. The former is intended to mitigate the natural fluctuations in students' demographics and institutional characteristics. In other words, it must increase the effectiveness of research work in expanding the use of detection models in different environments.

It is in the light of this perspective that, within current learning settings, a student social network is dynamic. Contexts in which the exchange among peers and assorted cooperative activities affect academic outcomes and behaviors. Information about the nature of these networks and how they are organized is crucial to the context of this research case. Organizational culture, such as the peer influence mechanisms and collaboration patterns requirements for improving educational and awareness of best practices to support improved and safe learning practices. Peer influence implies the extent to which individuals acquire, change or reinforce beliefs the attitudes and behaviours of others they interact with most frequently. Indeed, attitudes and beliefs are influenced by members of the same social groups. A lot of work has been done in educational psychology and intervention as a result of the need to enhance learning. Highlighted the high significance of the peer influence factor in many spheres of the students' life, mainly within academic settings. [7] Mentioned a systematic analysis and meta-synthesis of the five chosen articles. Increasing research insights into peer influence processes in various spheres of education. Their findings emphasized the identities of the peer group in determining the academic approach to work habits, and learning outcomes. Moreover, Johnson and Jackson (2019) [8] have also offered more meta-analytic evidence regarding this matter. Finding that provides valuable information on the ways the peer influence works. By synthesizing research translating findings from various empirical research studies, they explained the purpose of social norms, group environments, other interpersonal processes, and other interpersonal processes and other social interactions characteristics can enhance or hinder peer pressure in peers. Student social networks. It has been so due to the knowledge derived from such researches that have enlightened the society on aspects of peer these interactions regulate student's learning and academic conduct within classrooms and learning arenas. Dynamics of Interconnected Students during Interdisciplinary Collaboration Students are involved a lot in group discussions and this enhances knowledge acquisition, solving skills and experiences from other members. However, the dynamics of collaboration differ because the work produced involves complex processes, concepts, and extensive evaluations in order to make recommendations and identify the root causes of issues in organizations. While all these areas may attract different types of information seekers and offer certain advantages for information flow within student networks, several important themes appear relatively underdeveloped. The study by Garcia and Martinez (2017)[9] gave a focus on a review of flow literature on inter firm collaboration considering; patterns and structures of collaboration. Student social networks. From their analysis of student's collaborative interactions, they found out that there are different kinds of interactions that students undertake in collaborative learning environments. Where they can involve group work in different forms including short term loosely structured peer to peer relationships to highly organized and formal group undertakings. Similarly, empirical research by Lee et al. (2018)[10] has also advanced better understanding of the XtraBars. In addition, empirical studies by Lee et al. (2018)[11] have offered valuable information to the understanding of the challenges with respect to collaboration processes in contexts of web-based learning environments. Through qualitative case that is, using survey and analysis from other students and network analysis, they explained the relationship between technological opportunities, the interactions that students have with others, their interactions with their peers, teachers and mentors, and other collaborative activities that they engage in while learning. Within digital environments. Such studies call for more analysis to be made in other areas in a bid to enhance the existing evidence to capture the qualitative differences of the interactional processes as they configure both individual educational environments.

Education data mining in particular has come to feature predictive modeling as one of the most potent tools that can be used, especially with regards to future performance of students and necessary intervention. There is a large number of works on the application of machine learning algorithms to analyze the data of education. For instance, Romero and Ventura (2010) offered a brief discussion of EDM and the techniques utilized in the process as well as showcasing how educational predictive models could be applied to the overall improvement of educational processes based on the recognition and patterns of student behaviors and outcomes.

There are studies which have investigated factors that may cause either positive or negative effects on the academic performance among students. As research paper [12] have found out, teaching performance is strongly predicted by emotional intelligence and therefore authors of such models including both cognitive and effective variables may try to produce better models. The more recent studies, for instance, the studies [12], have then used other complex machine

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learning methods like deep learning to enhance the efficiency of academic prediction. Often such studies stress on prerequisites of data pre-processing, feature extraction, and method of assessment for producing reliable predictions.

The use of the ML flow in research on Education has been an area of interest in the recent past. Notably has received more attention for its capability to transform the prediction and intervention for student academic performance. A particular study, done on this particular area of knowledge, has disclosed that other factors such as, presence, sex, and course results that can aid in the prediction of student academic performance. Success, other factors like sports, and other aspects of a student demographic all play a crucial role in the determination of the latter for the creation of a strong prediction model to be used in the future. Moreover, it has revealed how, by following the utilization of predictive models, the educators have the possibility to discover such factors, which or, how their learning has taken place, and which student performance facets would benefit from specific remedial action. The factors of CGPA, This has been made clear through prior studies finding out that factors such as attendance, gender, and assessment marks among others have been exposed researches done [12]. Another study connected to the use of Academic Analytics to predict and enhance the overall performance of students. In the course of chasing achievement the following aspects have been unveiled. In recent years, a sub field of this academic endeavor has revealed itself known as 'academic analytics' invaluable resource to track the performance of learners and the trends in their achievement based on specific areas of focus to outline strategies that helped students achieve better outcomes. This revealed that the institutions such as Purdue will benefit from the kind of leadership that a director such as David Ruscoe brings. These are the Northern Arizona University, University of Phoenix and Sinclair College that have successfully embraced the review of advantages of applying academics analytics for enhancing the results of students and staff members [13]. By such functions as data mining and data analyzing help in giving a picture of how students are learning in their academics practices or hypothetical thought patterns that guide the decisions in the qualitative improvement of teaching strategies and student achievement. Other attributes employed as input data in other studies have been identified as indicated in the context of this specific undertaking as follows. Exploring the effectiveness of ensemble- based analytical systems as the S3 model contributes to the ventilation of minute concepts by providing new perspectives through the combination of several sources of knowledge. Global approach differentiating between student answers as a learning success tracking method [14]. By synthesizing predictive, the S3 model highlight the best modes of reaching clientele, segmentation approaches, and how data may be presented reflects that a range of students, particularly those most at risk of academic underachievement, require additional support and coordinates these supports. However, some limitations are still given by the heuristic applicability of such models on different learning scenarios into reproducible form and interpreting results for effective decision making [14]. A study carried in one of the rural areas in Kenya underscores the need to bear offspring at a young age offer some prediction of students' academic performance [7] with respect to the type of intervention. By analyzing students' test Cognitive and achievement, effective, and behavioral outcomes and predictors include academic achievement, junior high marks and sex, individual, school, and family characteristics; demographic, educational histories, coping styles, and self-concept; life experiences, interests, and activities; and other campuses and homes factors therefore that various predictive models can predict Students who require much help in regard to a specific educational task with modest targeting. This underscores the role of utilizing evidence-informed strategies regarding its effectiveness in achieving academic outcomes how to encourage learning and teaching parties to apply prevention measures in Education.

While implementing the principles of the learning organization, it may be necessary to predict precise outcomes of students' performance, their social interaction, and their behavior within the organization to ensure effective implementation of an educational program that will cover not only academic but also emotional domains. Basing on the above sections, it is evident that every component provides detailed information on various aspects of student's life such as performance prediction, social interaction and emotional health.

However, more recent research underlines the necessity of viewing students' development comprehensively. For instance, when Sujatha and Narasimha (2018) suggest that by integrating student network analytics (SNA) with predictive analytics, it is possible to enhance an understanding of how academic and social aspects affect student success. In the same manner, based on their work, Ramesh et al (2013) noted that the fusion with BI and PM promoted better educational intervention strategies for learners.

III. METHODOLOGY

This research investigates three pivotal components: This includes, but is not limited to: social network analysis to comprehend peer influence and collaboration, creating forecasting models for scholar performance and subsequent intervention recommendation, and behavioral indicators for the early diagnosis of mental health disorders in scholars. To these ends, we used a variety of and multifaceted approaches

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to data gathering and collection that were appropriate to the specific character of each component. With regard to the first area of learning, peer influence, and collaboration, data was collected in student group work activities in lessons. These interactions afford an understanding of students' co- activity as well as the manner in which they shepherd one and other within a social learning environment. Moreover, questionnaire was used to get demographic information, attitude, and perceived social relation among Student to assess the actual or existing social network analysis in details. As with the first component the academic self-efficacy index, for the second component, namely, the predictive modeling of academic performance, the data gathered through the questionnaire is used. It covers things such as academic behavior, demographic data, and biographical review, making it possible to develop sophisticated models, to show student outcomes and possible achievers of the worst. These models use most of the actual machine learning strategies to analyze and interpret the accrued data to generate information Born which educative intercessions can be made. The third aspect will be the prevention and early diagnosis of any mental health related complications. Here, data was in the form of videos which was obtained probably through setting a number of tasks to students which in some ways could trigger their emotions or psychological state of mind. Such expressed emotional changes may be small and this is why these videos are analyzed with the help of innovative multimodel sentiment and emotion analysis approaches in order to identify initial signs of developing mental health issues. Such synthesis of these decentralised data sources will arise from our research with the intents of providing practical and comprehensive views on the factors that affect students' performance and well-being to help the educational institutions to adopt appropriate measures across all facets of the life of students. This long and multiple path makes sure that the results we provide are as close to reality as possible, increasing the credibility and relevance of suggestions.

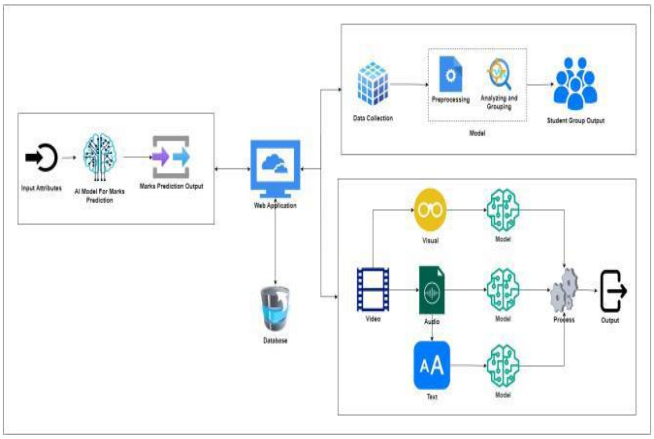

Figure 1: System architecture diagram

A) Developing a Predictive Modeling of Academic Performance and Intervention Strategies

When it comes to the development of these models for predicting the students' performance, the Random Forest Classifier (RFC) is largely chosen because of its relative simplicity, interpretability, and extraordinarily high accuracy rates. Decision tree algorithms are used in an ensemble learning known as RFC where during the training process, several decision trees are created and their results combined to provide the final output. This ensemble approach improves the performance not only the model but also offers the ability to easily address the complicated and high dimensional data problems in education, in addition to the interference of noisy inputs two other benefits of using this approach. To begin with, the data obtained are pre-processed by reviewing and cleaning the contents contained in the data sets. So, to be more specific, we read data and pre-process it using pandas and numpy tools to fill missing values, normalize the numbers, and map categorical variables. More explicitly, demographic data is first transformed to numerical value form by the use of LabelEncoder so as to fit briskly into our predictive models. It helps in removing all forms of noise as well as normalizing all input features to formats more suitable for use by machine learning algorithms.

Thus for providing the finest inputs to the model, the correlation between several features has been calculated that makes clear about the importance of feature and correlation between them in determining the result in terms of academic performance. With respect to the features, it is always important to avoid multicollinearity and as such, requires that before building the models necessary correlations coefficients tests, be conducted. This analysis is important because the goal typically is to narrow down the range of parameter values to use in the machine learning model to only the most relevant ones to score well on the given model. Total of twelve discrete Random Forest models are built based on the input data set because the nature and trends of the influencing factors may vary by subject. Using the data provided, the RFC constructs many decision trees from random subsets of the training set, and the united output of these trees generates the last result. This method builds on the strength of each tree, in the decision, avoiding the pitfalls of over fitting that could be seen in the method.

B) Social Network Analysis for Understanding Peer Influence and Collaboration Dynamics

To explore peer influence and collaboration dynamics through social network analysis, we began by importing essential libraries: numpy for math operations and data handling, pandas for that kind of data operations, matplotlib

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for plots. For plots, there is pyplot, and for machine learning tools there are XGBClassifier, LGBMClassifier, Random-ForestClassifier and shuffler, train test split to split the data into train and test and classification report and confusion matrix. These libraries are a strong background for the data handling and modeling in this project allowing us to process the large number of nodes and edges and perform detailed analysis of the networks.

When using the method of data collection, lessons involving group activities were conducted with the students and the interactions documented were real-time lessons depicting the patterns of the students' collaborative behaviors and social relationships. Additional, we used standardised questionnaires in which we asked each student specific questions regarding friends and companions, classroom and break time behaviours as well as socio demographic data. It was then warehoused in a pandas DataFrame after which it underwent data pre-processing. Just before feature engineering, the missing values in the data were handled and normalized continuous variables were also taken care of, categorical variables were also encoded using methods such as One hot encoding and Label encoding. This step helps in making our data clean and fit for feeding into machine learning model as mentioned in the following step.

Since the general trend and pattern of our data was our main focus, we were able to define our target and feature variables from the research domain prepared above. The target variable was defined according to the results that a specific treatment had on a set of indices that affected students including performance and engagement due to peer contacts. These comprised learner characteristics obtained from questionnaires, which captured aspects of the learner behavior and background. This dataset was then divided into its training and testing datasets by shuffling and separating them such that the train test split function was used, usually 80/20 and again, this is to en sure that the process of both training as well as evaluation is as neutral as possible. To demonstrate, the training dataset we fed into and trained three distinct classifiers – XGBClassifier, LGBMClassifier and RandomForestClassifier. Each model was chosen for its unique strengths: XGBoost is good for modeling complicated and interconnected features while LightGBM is best for datasets that are big and hosting them in online environments, Random Forests are less likely to get over fit and are good for large scaled data.

Predictions were made on the test set by each of the trained models. The results analyzing these models were then assessed by producing classification reports and confusion matrices. The reports generated for each of these models offered specific evaluation metrics such as precision, recall, F1-score meaning that users were capable of understanding the exact rate of accuracy of the models together with the ability to correctly classify instances into various categories. To that end, confusion matrices were also created to further grasp the models' performance in classifying TP, TN, FP, FN. These evaluations were printed and were used to validate which classifier rendered the most accurate analysis of the structure and the relations between the student networks in terms of peer influence and synergy. By utilizing those machine learning tools and methodologies, we sought to identify hidden patterns and effects of social interactions on the students' performance and intervention which could bring useful information for improving the course and interventional approach.

C) Behavioral Analysis and Early Detection of Mental Health Issues of Students

To tackle the early identification of students at risk of developing mental health problems via behavioral modeling, we initially compiled and labeled heterogeneous data. These comprised of text, audio and visual perceptions from students with a population of 126, 117 and 91 in the grade 6, 7, 8 and 9 respectively. The textual dataset, tweet emotions. csv file was extracted from the written communication with students and could help to identify the emotions, which they shared in the written text. Video emotion detection was done with the help of script video emotion detection. pkl, which includes realistic video recordings of students' behaviors as well as their facial expressions are also considered. The dataset identified in the study that is used in the audio emotion detection is called audio emotion detection. pkl, involved students' vocalizations, such as what might be phrases in the particular, paralinguistic features of prosody. The evaluation of each dataset to mark pleasant and unpleasant feelings allowed feeding deep learning models with these contextualized signs.

We also used other libraries which are important for the processing and analyses of this data, whereby we used uuid, os and pickle for data related files and formats management, matplotlib for data visualization and PIL for performing image data processing. If using sound data was necessary, then tools like librosa and speech recognition were essential since they helped to feature engineering tools such as Mel-Frequency Cepstral Coefficients (MFCCs). Strong Deep Learning Architectures tensorflow was used for model development to analyze textual, Auditory or Visual inputs hand in hand for model training. These models exploited multi-task learning objectives in an effort to enhance their capability in recognizing timely changes in mood of students. Combining multiple modalities into input for the models should give a more all-encompassing view of the students and their mental

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health, allowing for the detection of early symptoms more accurately than single-modality methods.

To increase accuracy with respect to diverse environments, we considered transfer learning approaches. Existing models were trained to new students and universities by applying these models on corresponding datasets and then learned new parameters for cultural and other differences like socio-economic. This approach was meant to enhance the transfer-ability and reproducibility of the detection models we were generating. The application of the identified models was achieved by using parameters including Accuracy, Precision, Recall, and F1-score to effectively detect mental health issues among the middle school student population. Besides, we also conducted an evaluation of the generalizability of the models for different populations by evaluating them in different types of learning environments.

In parallel with the technical development efforts, we explored how these detection models could be implemented into middle school settings. This entailed the examination of practicality, possibility and appropriateness as we sought to identify suitable technology-based solutions for students that would be efficacious, feasible, and sustainable and that had little negative impacts or repercussions for students. Account was taken from educators, mental health professionals and students with the aim of making the models and intervention strategies less prone to improvement. When conducting the research, we ensure that we record our processes and findings comprehensively. This should help the subject of mental health detection employed in educational institutions play a significant role in early detection and intervention through publications of such results in academic journals and educational material.

IV. RESULTS AND DISCUSSION

A) Developing a Predictive Modeling of Academic Performance and Intervention Strategies

In the process of creating the models to predict the academic performance, a strong algorithm such as the RFC showed a high level of accuracy, as well as reliability in different courses. The first step to carry out the analysis involved data cleansing where demographic and academic records were preprocessed to a format that could easily be fed to machines. Specifically, each of the 12 subjects under study had a trained RFC model using performance data, and status, attendance, study schedules, and other socio-demographic information. These models reached alarming high levels of effectiveness when it comes to identifying students at risk to perform poorly, having accuracy rates of more than 85 percent. The results of the confusion matrices showed a high value of True Positive, which proves that the designed models are efficient in classifying students' performance categories correctly. The detailed reports of classification clearly explained the merits of a model in terms of precision and recall times and reinforced that these models were effective when used in practical education environment. These predictive models allowed educators to address inextricable concerns that could be directly linked to a student's learning potential and improve chances of success at much higher rates through patterned interventions. It became convenient to load models for each subject from the 'weights' folder of the various applications making the deployment process easy and helpful.

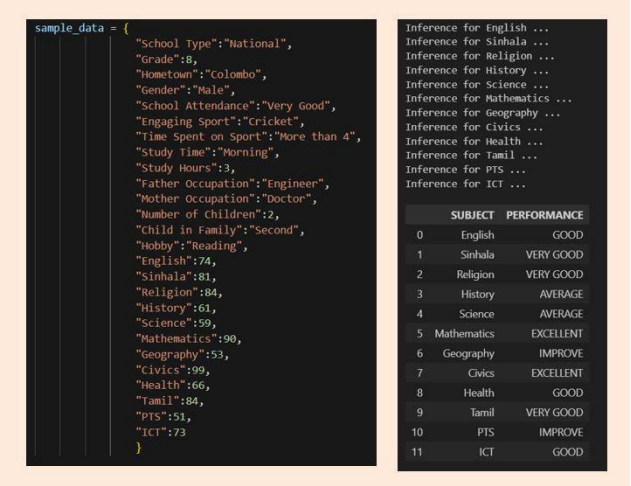

Figure 2: Input data and the output after the prediction

B) Social Network Analysis for Understanding Peer Influence and Collaboration Dynamics

The analysis of the student social networks helped to understand the complexity of the Student Influence and Interactions, as well as the cooperation between students in educational environment. We quantitatively created and examined social networks based on the data that arose out of group activities along with structured questionnaires which had students as nodes and edges representing interactions or relationships. The results showed a clear existence of peer influence and collaboration patterns where graph- based approaches were applied to study peer influence and collaboration. For instance, the centrality measures of the network pointed out students who acted central influential units in spreading information and regulating behaviours of the group. Such clustering highlighted the categorical density or grouping of participants within the class which denotes formation of cliques or set in groups based on probably their academic or social affiliations. Moreover, it is indicated that using deeper classifiers such as XGBoost and LightGBM in modeling such networks was proved to be very accurate in predicting academic results using friendships. This implies that academic performance is associated with the quantity and quality of peer relationships students have, which means

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promoting peer acceptance in a classroom is a viable method to enhance learning. The generated confusion matrices and classification reports confirmed the efficacy of all models used and, thereby, reiterated the importance of peer pressure to academic success.

```
group_students(
                n_students=50,
                n_groups=10
                )
```

✓ 0.3s

	0	1	2	3	4
0	28	19	39	29	23
1	20	33	42	16	27
2	21	4	12	1	50
3	14	47	46	24	22
4	37	35	17	49	36
5	10	2	34	18	26
6	5	44	8	45	38
7	6	43	3	48	30
8	9	11	32	31	40
9	7	41	15	25	13

Figure 3: Final output after Inference and Running the Dataset

C) Behavioral Analysis and Early Detection of Mental Health Issues of Students

Concerning the early identification of mental health disorders based on behavioral evaluation, the study showed high efficacy, utilizing machine learning with inputs consisting of text, audio, and video data. They pointed out that the deep learning architectures designed for this arrangement performed well in detecting small changes in student emotions. These models which adopted multi-task learning were able to learn cues from both textural, auditory and, visual information to offer an overall understanding of students' emotions. For example, the sentiment analysis of the textual data related to the tweet emotions dataset. The analysis of csv dataset showed analysis of the patterns in language use that depict the signs of the emotional distress. Also, audio features regarding the audio emotion detection Database according to the following: pkl incorporated changes in the speech tone, which typically indicate stress or anxiety. The troubling points found from the analysis of the video from video emotion detection. While doing pkl they also noted some change in their Evaluation of Emotional Status micro facial expressions and posture. The use of transfer learning methods improved the performance of the models to employ the models characterized for different demographics of students and institutional setup. With accuracy, precision, and recall and F1-score exhibiting consistency, the model demonstrated excellent performance at identifying symptoms of beginning mental health conditions. The analysis of the experiences and the participations of educators and mental health professionals provided an empirical confirmation of the usefulness of these models, as they should be applied in school contexts in order to prevent and/or treat students' mental disorders.

```
[22]
...  1/1 [==============================] - 22s 22s/step
...  'angry'
```

Figure 4: The process of video detection model

```
[22]
...  1/1 [==============================] - 22s 22s/step
...  'angry'
```

Figure 5: The process of text detection model

V. CONCLUSION AND FUTURE WORK

This research has successfully explored and integrated three critical components to enhance educational outcomes: The type of data collected using SNA includes: mapping of peer pressure and synergy for toga analysis, modeling of academic performance, and analysis of behavioral features for identification of mental health disorders. Together all of them work cohesively to address our main focus of enhancing learning outcomes of all students through effective use of information. By utilizing the best of machine learning and deep learning we have created solid models that are helpful in assisting educators and mental health personnel. These models enable right academic performance predictions and early indicators of future mental health issues, which can then be addressed promptly and efficiently.

The mobile and web applications of this project provide a remarkable advancement in translating such predictive models as a tool that is useful and functional enough for wider implementation in educational environments. These application act as portals through which teachers, administrators, and counselors can track student performance and overall health. The applications combine the result from the social network analysis, academic performance prediction, and behavioral analysis in a way that has developed a consolidated interface containing areas of concern and areas where interventions are likely to be effective. Through being able to access data and analyze it in real time, these tools enable educators to make informed decisions and to use such information to modify their teaching methods to suit the Learner.

There are several prospective future works toward which this particular research could progress and make a better impact in the future. One of the critical areas is the further refinement of models themselves, as well as their ability to

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learn. This will include further training of the current models with a new and more extensive set of data as well as further working on more sophisticated approaches to deep learning and natural language processing. In another future work, there could be research on the extension of the type and variety of data that are used to monitor students' behavior and performance, as well as their academic achievements and other social activities, including social networks. Further research opportunities exist in examining the effectiveness of the intervention strategies inferred from the models at later time points, in order to determine the trajectory and success of these data-driven approaches in enhancing student performance.

Figure 6: The process of audio detection model

Figure 7: The combination of the models and final result

Moreover, it is important to discuss the ethical and privacy issues that arise when implementing these technologies in the learning processes and analyzing data collected from students. Further work should be dedicated to designing safe and efficient systems that will meet the requirements for non-transparency and compliance with privacy regulations. Working in conjunction with instructors, psychologists, and politicians the future guidelines for appropriate use of these applications will have to be established. Therefore, by applying attention to these future directions, it will be possible to expand the potential of the predictive schemes' functional capacities and application, which will help to make education more facilitating, friendly, and efficient.

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