

Analyzing and Predicting Academic Behavior from Peer Pressure Indicators Using Machine Learning

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Abstract

The academic achievement of a student is determined by their capability, but also by the companions with whom they associate. Friends can have a positive impact on students' motivation for school, and at times friends are distractions leading to a lack of attention on their school assignments. This particular study focuses on the number and quality of companions students associate with and to what extent that could be used as a predictor of future performance in school by utilizing computer technology. Peer pressure is an influential factor and impacts academic achievement, and therefore this study will focus on the relationship between peer pressure and academics through machine learning methods, resulting in predictive assessments for students similar to this population. The present research gathered student data through two means: survey and record review. The research identified members of students' social networks who significantly influence student performance. A conceptual model was developed based on the key social network factors identified in the analysis. Computer programs known as Decision Tree, Support Vector Machine (SVM), and Random Forest were utilized to explore how these factors influenced student performance. It was discovered that how peers value and treat each other influences student performance. Random Forest was determined to be the superior computer program for predicting student performance. Educators could use this study's results to identify students who may be negatively influenced by peer pressure; thus, they might be able to intervene prior to major academic difficulties. Although academic performance is impacted by an individual's effort and intelligence, the social and environmental context in which students find themselves considerably influences their behavior. Peer pressure refers to the impact of peers on the individual, causing an individual to behave in accordance with a group's norms. In general, peer pressure can either facilitate or hinder academic achievement. On one hand, positive peer pressure encourages students to work hard and achieve their academic goals; whereas, negative peer pressure encourages procrastination, reduces one's participation or engagement level in school, and increases engagement in unproductive behavior. Through statistical analyses, this study will evaluate the degree of peer influence on a student's academic behaviour in order to develop predictive models to identify behavioural patterns early on. Using machine learning algorithms, educators will be able to identify students who may show detrimental behaviours and proactively provide interventions that are tailored to the individual student's needs.

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INTRODUCTION

There are many factors that affect a student's school-based behaviours. Academic behaviour is largely determined by how well a student can think and learn; students' self-perception; and student-to-student relationships. Another major factor is the influence of the student's peer group. Many students observe and try to emulate their

peers' behaviours (e.g., their friends may begin regularly studying or being more active participants in class or share the same attitudes about school).

The behaviours of students are influenced by the behaviours of the peers that they associate with. Most of the educational institutions rely on traditional academic evaluation methodologies, which are based on childhood academic performance, scoring (grading) and attendance records. Therefore, while these methods are useful, they do not provide an accurate assessment of a student's overall development, nor do they accurately represent the social dynamics that influence student behavior at school and home. Therefore, a student who has been influenced by his or her peers will only be identified after their grades decrease and, thus, the importance of including these social dynamics in the academic evaluation process is demonstrated through the development of appropriate academic assessment tools.

The advent of new technological advances in the field of machine learning has created opportunities for the analysis of complex datasets, comprised of both behavioral and social attributes using new analysis techniques that allow for detecting patterns, which were previously difficult to identify, with traditional methods. Based on these developments see, there is a need to integrate indicators of peer pressure into existing academic performance measures/records in order to better understand student behavior and improve the provision of academic support to students [1].

PROBLEM STATEMENT

There is a significant amount of influence on students by those around them, which can have an influence on their behaviour. However, in the majority of instances, many school-based systems that monitor students are not able to take into consideration the influence of their peers. When teachers monitor student performance, they tend to focus only on attendance/grade point average/test score. Thus, teachers may overlook students struggling with issues such as peer pressure or poor behaviour. When students are pushed into poor behaviour/disregarding schoolwork due to pressure from others (often referred to as "peer pressure"), this has a direct and powerful influence on students. Therefore, peer pressure is an important consideration in understanding the behaviour of students.

When students surround themselves with bad influences, they may often be less motivated to complete their schoolwork. They may take much longer to complete tasks because they are bored, or they may become uninterested in doing well in the classroom. Whereas, students who associate with positive influencers typically achieve higher academic success and more consistently achieve their academic goals. An issue that is currently present within the education system is being able to determine how much of an impact friends/peers have on students, as well as the future implications of these impacts. Peer pressure among peers is a reality to students and therefore needs to be addressed when we want students to perform their best in school. The lack of predictive models that incorporate peer pressure indicators makes identifying at-risk students early on difficult for educators. The goal of this study is to fill the current gap by developing machine learning models which examine both peer pressure indicators and students' academic records in order to produce predictions for academic behaviour and performance trends [2].

RESEARCH OBJECTIVES

This research aims to comprehend the impact of peer pressure on student behaviours and ultimately build models of what may occur as predicted through machine learning techniques.

The reason for this research is to examine how peer pressure, both positive and negative, affects the academic performance of students. We would like to identify what the main indicators of peer pressure are and how they relate to academic performance. Finding out how peer pressure impacts academic performance will help us better understand how peer pressure can negatively impact performance.

We want to see how students act with their peers; we want to see whether they do things just to fit

in with their peers and whether peer pressure is negatively impacting their academic performance. Our main goal is to identify the major indicators of peer pressure and how they affect academic performance. Data will be collected on the academic and behavioral indicators of academic performance to allow for analysis and implementation of machine learning models to predict academic performance by utilizing Decision Trees, Support Vector Machines, and Random Forests. The accuracy of the results of these models will be measured using standard evaluation metrics and will be useful for educators in developing strategies to minimize the negative impact of peer pressure on academic achievement [3].

RESEARCH CONTRIBUTIONS

The study is aimed at enhancing the understanding of educational analytics through a dual behavioural & computational methodology. Existing research studies typically look at academic success based upon criteria such as grade point average, attendance, and test scores. This research expands on these considerations by exploring peer pressure as a behavioural input that affects students' academic performance. The primary contributions of this research are:

A dataset that integrates records of students' academic performance with survey data on peer pressure, thereby creating a more comprehensive dataset for analysis of academic behaviour;

Identification of parameters associated with peer influence and involvement affecting students' study habits, motivation levels, and levels of involvement in school [4].

Implementation of machine learning models, including Decision Tree, Support Vector Machine (SVM), and Random Forest models, as tools to predict academic behaviour based upon social & behavioural parameters;

Conducting comparative evaluations of the above mentioned models in order to determine potential for improved accuracy and interpretability when assessing/making predictions for student behavior.

Providing practical recommendations and insights that can assist both educators and policymakers in developing strategies that encourage positive peer group interactions as a means to enhance overall academic performance [5].

THEORETICAL BACKGROUND

Extensive research within the field of educational psychology has revealed that an individual's academic performance is influenced by both their personal characteristics and the environments in which they exist; therefore, there is no way for students to learn independently as every student experiences continuous interactions with his/her teachers and peers, as well as within his/her entire academic environment. Of all the factors that affect students' academic behaviors, peer pressure has a direct impact on how students approach academics. Peer pressure can be defined as the pressure placed on individuals by their peers (people of the same age and/or social group) to conform to specific attitudes or behaviors. In the academic environment, this pressure can impact certain academic behaviors (e.g., study habits, class participation, time management, and following academic standards) in both positive and negative ways based on the type of individual with whom they are interacting [6].

The basis for this theory stems from Bandura's Social Learning Theory. Social Learning Theory states that people can learn by observing and imitating the behaviors of others. In the academic environment, when students observe the level of effort and seriousness with which their peers approach academic tasks, they will often imitate those behaviors in the way they approach their own academic tasks. Ultimately, this process will lead students to adopt and maintain academic behaviors similar to those exhibited by their peers.[7]

Positive peer influence can encourage cooperation and provide motivation while promoting healthier types of competitive behaviour, which can also promote higher academic performance. Conversely, negative peer influence can lead to academic disengagement due to stress or changes of priority away from academic goals. By understanding these theoretical constructs, one can gain insight into how much essential peer pressure impacts academic achievement and enables the creation of predictive models of educational success.

RESEARCH METHODOLOGY

This section provides a description of the methodology that was followed to analyze the influence of peer pressure on students academic behaviours. In order to do this, predictive machine learning models were also developed. The methodology had three major components, namely the workload design, data collection, and data pre-processing to model evaluation.

WORKLOAD DESIGN

The workload resulted in an analysis of academic behaviours affected by peer influence, and predicted them as they would occur under realistic academic conditions. The workload was conceptualized off of the types of interactions and behavioural patterns students typically exhibit in educational settings.

The source of the workload was through student surveys, questionnaires, and academic record data to include peer influence indicators as well as academic performance indicators. The tasks to develop the workload were; data cleansing, feature selection, correlation analysis, and prediction using machine learning models. To evaluate model performance under different conditions, the dataset was divided into training and testing sets. Data was collected across different academic periods to reflect variations in student behavior over time. The design also ensures reproducibility by using consistent datasets and machine learning configurations for repeated experiments [8].

DATA COLLECTION

The data collected were from 300 people; they included students in both undergraduate and postgraduate levels. The data consisted of two components:

- *Survey Data:* We surveyed participants in order to obtain statistics on motivation (group study habits, peer comparisons) and how motivated these students were socially, and we did this in a Likert scale; on a point scale of 1 to 5 (where 1 = Strongly Disagree and 5 = Strongly Agree).
- *Academic Records:* Academic records included; attendance, grades, and how often they participated in near to or at least 50% of their classes (from previous year). Grades and attendance were obtained after obtaining institutional approval, and ethical consideration was addressed by providing informed consent for all participants and maintaining student confidentiality.

DATA PREPROCESSING

Data preprocessing involved the cleaning process. The cleaning process involves the removal of incomplete, duplicative, or inconsistent records. All numeric data features were normalised so that there was uniformity within Feature sets. Categorical records were encoded in numeric values, and the remaining non-numeric features were treated as numeric values in order to process correctly through the model. Lastly, Missing data were handled using either mean or median imputation methods which ensured that the resulting dataset was appropriate to use for effective training and evaluation of the predictive models.

PERFORMANCE METRICS

To assess how accurately these predictive models can forecast the occurrence of a particular academic behavior, standard performance metrics were applied to assess the accuracy and reliability of the forecasts generated by all models. Accuracy was calculated based on the ratio of total number of correct academic behavior forecasts to the total number of academic behavior forecasts. Precision and recall provided an assessment of the accuracy and completeness of the positive predictive

forecasts [9].

To assist in conducting a balanced evaluation of the predictive accuracy, the F1-score was computed to combine precision and recall. Regression-based prediction models could be evaluated using the mean squared error (MSE) to assess the prediction error for regression-based models. The confusion matrix also provided a method for visualizing the classification performance of all models, as well as the distribution of errors in the various categories of forecasts [10].

DISCUSSION

According to the results of the study, academic behavior is heavily affected by peer influence amongst students. Statistical analysis suggested that both frequency of social contact and the subject's study habits are significant determinants of academic success. Some students exhibited a strong level of influence from peers and were either steady and focused in their studies or had trouble concentrating and lacked motivation to achieve. Peer interaction may have both beneficial and detrimental effects on academic success based on the environment in which interactions occur.

All machine learning methods produced acceptable results; however, the Random Forest model generated the most accurate predictions (88% accuracy) indicating that better estimation accuracy is obtained when multiple decision trees are combined to obtain more reliable and generalizable results while reducing the possibility of overfitting than if each were done individually. Support Vector Machines and Logistic Regression produced similar results by providing accurate predictions for behavior-driven academic achievement outcomes.

There were limitations experienced during this research. First, the data used was limited to one distinct cohort of students rendering the generalizability of these findings improbable outside of this group. Second, many of the personal factors associated with a student's internal motivation, emotional health, and exceptional or unique circumstances were not considered; therefore, those factors have impacted the overall accuracy of the resulting estimates.

Implications for Practice

- *Academic Counselling:* This model can be utilized by educators to identify students whose academic success is adversely affected by peer influence
- *Restrictions:* The Standard of the data: Data Quality is essential to the performance of the model as predictions will differ considerably if the quality of the data that was collected is either low or does not have comprehensive information. Missing or inaccurate data can greatly impact the predicted results.
- *The Scope of the research:* The actual research conducted did not take into consideration other factors that may also contribute to the peer influence on how a student behaves towards academic performance, for example: Intrinsic Motivation, family environment, etc.
- *The Generalisation of the Model:* Each school/college can have considerable variation in peer dynamics which would affect how the Model can be applied across schools/colleges, therefore making it difficult for the Model to be generalize
- *Behaviour is Dynamic:* Both Peer Influences and Academic Behaviour are not Static – they change over time – therefore data needs to be continuously updated for ‘real time’ response/accurate prediction.

CONCLUSION

In this research, researchers investigated whether or not peer influence impacts student school behaviour, how computers can assist predict student success, the impact friendship has on studying; therefore, friendship influence, time spent together (where the students go), and how smart a student is when studying will also impact their level of performance. Of many computer-based models tested,

Random Forest was found to be the most accurate and effective for this type of research model, with great predictive capabilities for student success. The results of this research project will provide valuable information to teachers, counselors & parents, all of whom will be able to identify students struggling with their schoolwork and provide them with the appropriate support for their success. Consequently, peer influence can negatively impact an at-risk individual however, if teachers, counselors, and parents get involved to assist students when necessary, they can help improve at-risk students with their school performance.

This needs to be done in the future through research. This will be based upon gathering evidence from various schools and colleges of students who have come from different cultural backgrounds with the goal of having a more comprehensive understanding of all related factors and how they may impact an individual student's academic performance. Additionally, all types of characteristics can potentially impact a student's academic performance (e.g., academic motivation, emotional intelligence, family structure). If we do this, we can develop good predictive models for academic success of individual students. Also, the establishment of some type of system, where continuous data on an individual student is collected, would prove beneficial to both students and the educators because both will receive timely facilitating feedback and allow for early intervention on the part of the student regarding any issues. Besides, data collection efforts will provide privacy measures. Furthermore, it will be critical to utilize commercial software packages that can provide an explanation of the algorithms utilized for making projections as this will enhance the reliability and validity of the overall projected outcomes for use by educational leaders when making decisions.

Summary of Findings

- *Elements Influential in School Performance:* When we examine what contributes to student success, we see that students' peer attitudes, the frequency with which they participate in out-of-school activities, and their study practices are all influential. Peer influence; frequency of social participation; and good study habits are the most important elements when it comes to academic performance.
- *Performance of the Random Forest Model:* The Random Forest algorithm worked. It obtained 88% accuracy, and a F1 score of 0.85, indicating that the Random Forest model is an excellent predictor of outcomes. The Random Forest model is extremely reliable for prediction purposes.
- *Behavior Patterns:* Students with more friends and a greater degree of social interaction will have lower average academic performance than their peers with less social interaction. Although the students with higher levels of peer influence and social interaction do not all achieve similar academic results, many do; and some students with higher levels of peer influence and social participation achieve dramatically different academic results from their professional peers.

Future Research Directions

- *Larger and More Diverse Datasets:* Collecting data from a variety of different schools, colleges, and cultural contexts can assist with generalizability and the overall reliability of models.
- *Additional Behavioural Factors:* When discussing why individuals behave in certain ways, consideration of additional behavioural factors such as motivation, emotional intelligence, and family influence should be accounted for. These additional behavioural factors can provide insight into an individual's predicted behaviour. All factors mentioned above will affect how an individual will behave; therefore, including these additional behavioural factors will be helpful in predicting an individual's behaviour.
- *Real-Time Monitoring:* Real-Time Monitoring allows us to monitor students continuously. Systems capable of this type of monitoring provide means by which to identify potential trouble for students and intervene before experiencing additional problems. This can provide support to students at high-risk for falling behind. Real-Time Monitoring provides excellent locations for warning at-risk students.
- *AI Models that are Explainable:* Models AI that can help us with are models that can explain.

Explainable AI models use machine learning and algorithms that allow people to be able to clearly understand why the AI made its predictions. Because of this capability educators will understand how the AI models work so that they can make better decisions on using the models.

- *Approaches That Preserve Privacy:* We also want to use Approaches that Preserve Privacy when collecting data so that data is collected securely and fairly. This means that we must assess how to preserve the privacy of the student data that we collect. We would like to ensure that our predictions are not made less accurate by violating the privacy of students when creating predictions. Therefore, Approaches That Preserve Privacy are very important in that they enable the ethical collection of data.

Final Recommendations

- *Early Identifying At-Risk Students:* Finding students who are falling/risks from their peers should start at an early age using computer models to look for troubled students due to their friendship circle and once those students have been identified, we can provide immediate assistance such as counseling, etc. To reach the long term goal of giving these students the resources to achieve what is needed/happy to do to stay in school.
- *Personalized Learning Plans:* Create a personal learning plan for each student based on student behaviour and how they interact with their peers, thereby increasing their academic success. (Ask student to rate on a scale of 1-10 about their relationship with their peers)
- *Build Positive Relationships Among Peers:* In order for students to have positive relationships with each other, they need opportunities/activities that will bring them together to work together and learn together. We can do this in a fun way (through activities) to encourage them to be dependent on each other. If students have positive relationships with each other, they are much more likely to do well in school.
- *Connecting with parents:* Let parents know how their peers have influenced their child's performance will help with support from home.
- *Tracking student behavior and feedback over time:* Create a system to monitor student behaviors over time and give teachers information they can use to intervene promptly.

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