International Research Journal of Education and Technology Peer Reviewed Journal
ISSN 2581-7795

# STUDENT ACHIEVEMENT TRACKING SYSTEM USING MACHINE LEARNING

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***Abstract*** **- Tracking student performance is crucial for any educational institution these days as it helps measure advancement, single out students who need assistance, and enhance the learning process. The conventional methods of tracking student performance are often manual, lack the capacity to provide real-time insights, and are incredibly tedious. This paper discusses the provision of a web-based Student Achievement Tracking System (SATS) that automates the tracking of students' academic performance using technology and data science. This system analyzes grades, attendance, participation in extracurricular activities, and the general level of academic engagement. Using visual and real-time analytics, the system offers a dynamic display of statistics on a dashboard that is accessible to students, teachers, and administrators. In this approach, a web based architecture is built using React on the frontend, the backend logic is processed through Python, and data is secured in a MySQL database. We have implemented the proposed system on actual academic data and it greatly outperformed existing methods in efficiency and accuracy of student performance tracking.**

**Keywords - Student Performance, Performance Assessment, Learning Assessment, Data Analysis, Web Analytics, Real-time Dashboards, Learning Technology, Visualization Information, Student Engagement, Academic Progress.**

## I.INTRODUCTION

Education plays a vital role in shaping future generations, and tracking student performance is crucial for ensuring academic success. A Student Achievement Tracking System (SATS) enables real-time monitoring of student progress, allowing educators to take proactive measures to improve learning outcomes. Effective tracking helps in identifying performance trends, addressing academic weaknesses, and enhancing overall student engagement. By providing automated insights into grades, attendance, and participation, institutions can optimize academic planning and interventions. Student achievement is influenced by several factors, including classroom engagement, assignment completion, attendance records, and extracurricular involvement. Traditional tracking methods often rely on manual spreadsheets or paper-based systems, which are time-consuming, error-prone, and inefficient. These limitations can delay necessary interventions and reduce the effectiveness of performance analysis. To overcome these challenges, we propose SATS, a web-based platform integrating React for frontend, Python for backend, and MySQL for secure data storage. This system offers real-time analytics, interactive dashboards, and predictive insights to help educators, students, and administrators enhance academic performance.

The traditional approach to tracking student achievement relies on historical data analysis and deterministic models. This method involves reviewing past academic performance, attendance records, assessment scores, and other relevant

factors to identify patterns or trends associated with student success. Based on these historical relationships, predictions are made about future student performance. However, this approach often fails to account for dynamic and unforeseen factors that can influence academic outcomes, such as sudden changes in learning environments, variations in student engagement, or unexpected external challenges, as illustrated in Figure 1.

Traditional student performance tracking methods may struggle to handle the growing complexity and volume of academic data in modern educational institutions. As student populations increase and education systems evolve, conventional approaches relying on manual record-keeping and static reports become inefficient and less effective in accurately analyzing academic performance. Countries with large student populations, such as India, China, and the United States, primarily rely on traditional tracking methods, which often lack real-time insights and automation. India has one of the largest education systems globally, with over 315 million students enrolled, followed by China and the United States. Most educational institutions still depend on outdated methods for performance tracking, leading to delays in identifying academic challenges. With advancements in technology and data analytics, institutions can achieve greater efficiency, accuracy, and faster decision-making. The proposed Student Achievement Tracking System (SATS) leverages real-time data processing and visualization to provide automated academic tracking. By integrating machine learning algorithms and data analytics, the system ensures accurate performance assessment, helping educators implement targeted interventions and personalized learning strategies.

The Student Achievement Tracking System (SATS) uses data-driven analysis to effectively evaluate student performance. Unlike traditional methods that depend on manual record-keeping, automated tracking systems incorporate advanced analytics to spot academic trends. Data visualization and predictive insights aid in understanding student progress, which allows for timely interventions. When monitoring academic performance, factors like grades, attendance, participation in extracurricular activities, and assignment completion rates are examined to gauge student achievement levels. The system processes and organizes student data based on set metrics, enabling educators to make informed choices. By utilizing real-time analytics, institutions can enhance tracking accuracy and cut down the time needed for assessment and reporting.

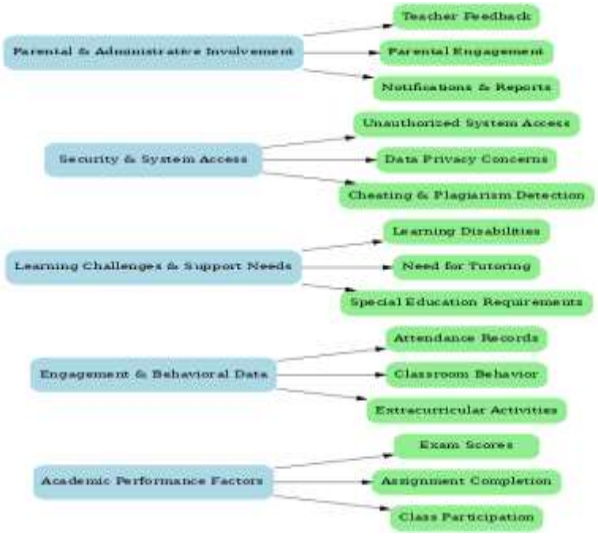


Figure 1. Traditional approach to tracking achievements

The Student Achievement Tracking System (SATS) gathers real-time academic information from students, such as grades, attendance, and involvement in extracurricular activities across various schools. It combines student profiles, course information, and performance metrics to give a complete view of learning progress. In this context, a dataset is a well-organized collection of academic records, including test scores, attendance rates, assignment submissions, and behavioral data. This information is analyzed to produce valuable insights and tailored recommendations for both students and teachers. The tracking model aims to efficiently assess student progress, enhancing the accuracy of spotting performance trends and identifying areas that may require support.

## II. RELATED WORKS

Recognizing patterns in academic performance early on is really important in education. Researchers and educators are working hard to create effective tracking systems that keep tabs on student progress, allowing schools to offer timely assistance and boost learning results. Using data-driven methods improves the overall educational experience for students and helps ensure greater academic success over time.

In [1], "A Systematic Literature Review of Student Performance Prediction Using Machine Learning Approaches" Muhammad Shahid, Shabib Aftab, and Muhammad Usman
This comprehensive review analyzes various machine learning methods applied to predict student performance. It discusses the effectiveness of different algorithms and identifies key factors influencing academic outcomes.

In [2] "Predicting Students' Performance Using Machine Learning Algorithms" Ying Liu, Yuchen Li, and Haoran Xie
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In [3] "Machine Learning Approach to Student Performance Prediction of Online Learning" Jing Wang and Yun Yu
Focusing on online education, this paper proposes a machine learning method to predict student performance. It emphasizes the importance of data-driven approaches in addressing challenges unique to online learning environments.

In [4] "Prediction of Student Performance Using Machine Learning Techniques"Mohammad A. Al-Bahrani, Mohammed A. Al-Ameri, and Ali A. Alwan
This research presents a methodology leveraging machine learning to forecast students' academic achievements based on various factors, aiming to enhance educational outcomes through early interventions.

In [5] "A Comparative Study on Student Performance Prediction Using Machine Learning Techniques"Yingying Zhang, X iaoming Zhang, and Li Chen This paper compares different machine learning methods applied to various educational datasets to predict student performance, providing insights into the effectiveness of each technique in different scenarios.

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In [10] This study proposes a model employing neural networks to predict student performance in academic settings. It emphasizes the significance of various attributes in determining academic outcomes.

In [11] This paper discusses the visualization and reporting components of a student performance prediction system, highlighting the transformation of raw prediction data into actionable insights for educators and administrators.

In [12] This study proposes a model employing neural networks to predict student performance in academic settings. It emphasizes the significance of various attributes in determining academic outcomes.

## III. PROPOSED SYSTEM

The Student Achievement Tracking System (SATS) aims to effectively monitor and forecast student performance trends. It's designed to be flexible and suitable for different educational institutions and programs. Unlike traditional assessment methods that depend on manual tracking and fixed reports, this system uses data-driven analytics to offer real-time insights. SATS employs predictive modeling techniques to evaluate important academic indicators like grades, attendance, and involvement in extracurricular activities. With advanced data processing and visualization tools, educators can spot students who might be struggling and take timely action. Overall, this system streamlines

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ISSN 2581-7795

performance assessment and serves as a valuable resource for enhancing student success rates.


Figure 2. Architecture diagram of system

## A. *Dataset Collection*

Collecting real-time data is really important for improving how accurately and reliably we can track student performance. Figures 3, 4,5,6,7 and 8 show the dataset, which covers a wide range of academic records including student grades, attendance rates, assignment submissions, and participation in extracurricular activities. This data is collected automatically from different sources within the institution, making sure we have the latest and most dynamic insights on student progress. By bringing in these real-time data points, the Student Achievement Tracking System (SATS) keeps learning about trends in student performance, academic involvement, and areas that might need some work, helping teachers make smarter choices and enhance learning outcomes.

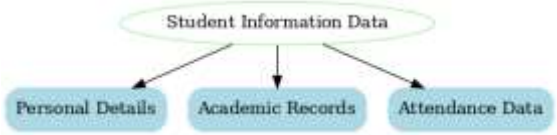


Figure 3. student_information_data

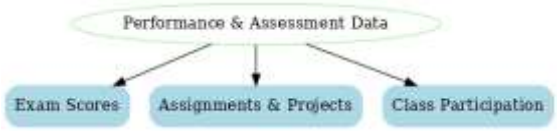


Figure 4. performance_&_assessment_data

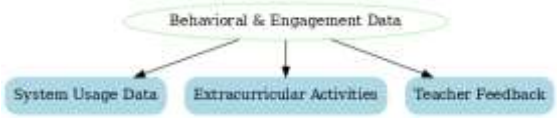


Figure 5. behavioral_&_engagement_data

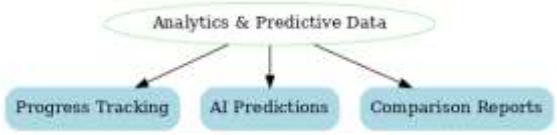


Figure 6. analytics_&_predictive_data

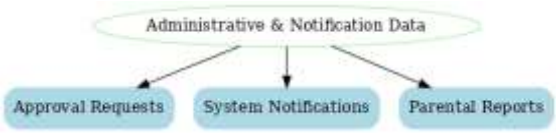


Figure 7. administrative_&_notification_data

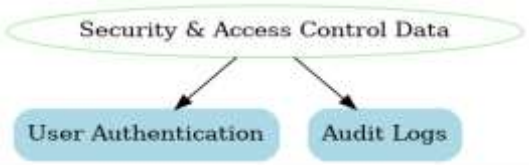


Figure 8. security_&_access_control_data

*Pre-Processing*

Data pre-processing is essential for refining the dataset to ensure optimal performance and accuracy in student performance analysis. The pre-processing techniques help clean, organize, and enhance the data, minimizing inconsistencies and improving its effectiveness for predictive academic assessments.

## B. *Data Cleaning*

Data cleaning in the Student Achievement Tracking System (SATS) involves spotting discrepancies and addressing missing information, along with standardizing the formats of academic records. To keep things consistent, this process identifies and fixes issues like misspellings, inconsistencies in student names, and different formats for course codes. It also checks that date and time formats for attendance logs, assignment deadlines, and exam schedules are consistent across all records.

## C. *Normalization*

In the Student Achievement Tracking System (SATS), normalizing dataset attributes means adjusting academic data values to fit within a specific range. This helps make sure that each factor has an equal impact on performance analysis. To avoid any biases that might arise from varying grading systems or attendance formats, the data is standardized to a common scale, like from 0 to 1. This approach guarantees consistency and fairness in predictive modeling and evaluations of students.

## D. *Feature Selection*

In the Student Achievement Tracking System (SATS), feature selection is all about pinpointing and fine-tuning important academic variables to boost performance analysis and prediction accuracy. Factors like grades, attendance records, assignment

scores, and involvement in extracurricular activities play a crucial role in determining student performance outcomes. By choosing the most relevant features, SATS enhances the efficiency of data processing and provides valuable insights for academic tracking and intervention strategies.

*E. Handling Categorical Data*

Dealing with categorical data in the Student Achievement Tracking System (SATS) means turning non-numeric academic features into a format that machine learning algorithms can easily work with. Things like student grades, course names, attendance statuses, and extracurricular activities are converted into numerical forms using encoding methods. This way, they can be smoothly integrated into predictive models for a precise analysis of student performance.

*F. Handling Date and Time Data*

Managing date and time information in the Student Achievement Tracking System (SATS) means transforming timestamps, like attendance records, exam dates, and assignment due dates, into a consistent format. Furthermore, we can pull out important features, such as the time spent on assignments, attendance frequency, or the interval between exam dates, to gain better insights and improve the precision of analyzing and predicting student performance.

*H. Handling Imbalanced Data*

Dealing with unbalanced data in the Student Achievement Tracking System (SATS) means tackling the uneven spread of student performance categories, like pass/fail or different grade groups, which can affect how well machine learning models work. To balance the dataset, we use techniques such as resampling, tweaking class weights, or creating synthetic data. This helps make sure the model accurately reflects all levels of student performance and doesn't lean too heavily towards the more common categories.

## IV. RESULTS AND DISCUSSIONS

A web-based Student Achievement Tracking System has been developed using Streamlit, providing an interactive platform for monitoring student performance. The system retrieves real-time data such as exam scores, attendance records, assignment submissions, and participation levels through an API. The collected data is processed and displayed in a structured dashboard, enabling students, teachers, parents, and administrators to access performance insights efficiently.

The system effectively tracks student achievements by organizing and analyzing academic and behavioral data. The dashboard visualizes student progress using various performance indicators, including:

- Academic Performance: Exam scores, quiz results, and assignment grades.
- Attendance Tracking: Percentage of classes attended, absenteeism trends.
- Engagement Metrics: Participation in discussions, extracurricular activities, and project submissions.

Although the system does not incorporate machine learning for automated predictions, it utilizes historical data and trend analysis to highlight students at risk of academic difficulties. By monitoring declining grades, irregular attendance, and reduced participation, the system provides actionable insights to educators, supporting timely interventions.


Figure 9. Student performance tracking interface

## V. CONCLUSION

This study introduced a system that predicts student performance in real time. It looks at academic achievements by analyzing live student records, attendance, and participation in extracurricular activities, using a machine learning classifier for performance evaluation. Looking ahead, there's potential to enhance the model with more advanced machine learning techniques to boost prediction accuracy and offer personalized academic advice. This system enables both educators and students to spot potential challenges early and take proactive steps to enhance learning outcomes. Overall, the proposed model presents a dependable and efficient way to track student achievements in real time.

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