EduMetric: An Interpretable Web-Based Analytics System for Predicting Student Academic Performance and Dropout Risk

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***Abstract*—The rising trend today in institutions of learning is the emphasis to enhance academic performance while at the same time decreasing dropout rates. Despite the constant generation of educational data like internal marks, attendance, semester performance, as well as behavior scores, the traditional monitoring system used in most institutions of learning is manual and inefficient. This type of system tends to be reactionary rather than proactive in nature. EduMetric is presented in this paper, being an extensive web-based analytical system for evaluating, monitoring, and predicting the academic performance and potential for dropping out of education using information related to the institution. Academic performance, attendance rates, and scores for behavior, which are directly set by mentors, are taken into account in the computation of performance, risk, and dropout probability scores using analytical scoring formulas that are heuristic and interpretable for academic institution personnel.**

Traditional prediction methods are not applicable here, which make predictions using black box formulas.

It has a modern full-stack technology solution that utilizes the Flask web application framework for back-end computations, the Supabase database (PostgreSQL) for safe and efficient cloud-based data management, while graphics of the interactive results are developed in Plotly.js. Now it has real-time analytics, drill-down displays, and sub-student-level views that facilitate predictive educational counseling. Observations gathered in experiments show that it has the capacity to classify students into appropriate categories concerning results, thus qualified for application in educational settings.

***Index Terms*—An Academic performance prediction, educational data analytics, student risk assessment, dropout prediction, learning analytics systems, academic decision support.**

I. INTRODUCTION

Lately, there has been an increasing need to track the academic performance of students in institutions of learning. The success rates of students, retention, and graduation are important indicators of how institutions are functioning. In the past, monitoring students' performance has been carried out using exams, class attendance records, and reviews carried out by lecturers. The methods have been inadequate in offering detailed information on the aspects of students' learning. With the rising trend of digitization in educational systems, institutions now produce massive amounts of data related to students. This data comprises semester-wise marks, internal mark sheets, attendances, and behavioral analyses carried out by mentors. Despite this data being possessed by institutions, it is seldom analyzed together in one go in real time. This makes professors rely on gut feel and feedback reports to zero in on students to provide early intervention help.

Predictive analytics in education: The problem predictive analytics aims to solve. In education today, predictive analytics in education has come up as one of the efficient ways of solving this problem. Predictive analytics employs past educational records

to try to establish patterns that might be linked to underperformance and dropout. In many predictive analytics systems that exist today, one of the major technologies used is black box predictive analytics. While predictive analytics might be accurate, this makes the system not entirely trustworthy. To mitigate these issues, this paper will introduce EduMetric, an interpretable web application for data analytics that integrates educational, presence, and behavioral data for the purpose of informed decision-making.

This application will feature ease of understanding, usability, and interpretability to allow faculty members to make sense of the insights produced. This application will also incorporate the use of dashboards and student-level data for decision-making.

II. SYSTEM DESIGN AND METHODOLOGY

A. System Overview

EduMetric is planned to be a client/server solution involving three principal components: Data Layer—This refers to the Supabase PostgreSQL database used for storing unprocessed and processed data concerning students, GPA records for a semester, attendance percentages, internal scores, and mentored behavioural variables. Backend: Python Flask Web Server

This system deals with REST APIs and data consolidation through data aggregation and scoring strategies, in addition to producing a JSON response, which is received by its frontend. Frontend—A dynamic web interface developed using the combination of HTML, CSS, and JavaScript for the visualisation of interactive charts based on the output received from the backend, developed using Plotly.js. This modular structure facilitates a real-time update of the dashboard, and the user has control of drill-down analysis functions in terms of departments, years, and levels of performance.

B. Data Model and Inputs

The collected d EduMetric accepts the following types of data for every student: Semester GPAs: (sem1-sem8). Indicate the level of performance attained on Internal marks, which are modelled on continuous evaluation. "Attendance percentage—attendance throughout academic periods." Behavioral Score—Score by mentor (0-10) = Indicates participation & conduct.

C. Heuristic Scorings

In order for the results of the predictions to be clear and easy to interpret, EduMetric adopts formulaic scoring rules instead of machine learning algorithms. The result for the performance score is obtained through the weighted formula for the internally evaluated percentage, attendance percentage, and the score for the behaviour. The formula used is: Performance_Score = (Internal% * 0.40) + (Attendance% * 0.40) + (Behaviour). The risk and return of a portfolio are related in such a Risk_Score = 100. It splits students into categories with labels such as high, medium, low, or poor performance, high, medium, or low risk. It is seen in the analytics dashboards and lists.

F. Figure

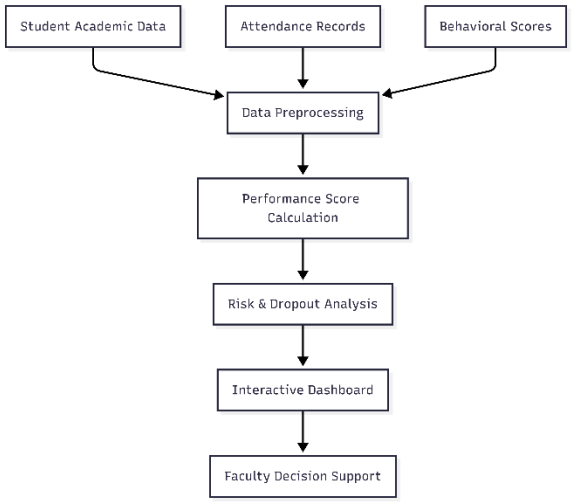

Fig. 1: System architecture of EduMetric

III. DATA PROCESSING AND VISUAL ANALYTICS

A. Backend Processing

Occasionally, the Flask server sends a request to Supabase through REST for student data. Once that arrives, Pandas teams up with NumPy to handle the number crunching. Averages come into view as learners are sorted according to their risk tiers. Simultaneously, attendance figures began to take shape. Each team works with its own chunk of information, which is kept separate. The polished data are displayed on the user interface. It flows along fixed paths shaped as JSON.

B. List of Topics Covered

The interface of EduMetric includes several important graphical elements:

KPI Tiles – Total number of students, average performance, number of at-risk students and so on. Performance Doughnut Charts – Group representations of the performance categories of students.

Department Comparisons — Bar charts and line graphs for comparison of performance measures for departments. Drill Down Filtering - Interactive graph segments that display a list of students based on certain criteria (for example, high-risk in a pool).

The plotly.js tool allows making responsive and interactive graphics, and the logic written in JavaScript takes care of data loading and visualisation.

IV. TECHNOLOGIES USED

EduMetric is made with reliable technology that helps it work well and keep data safe. The part of the system that users do not see is built with Python Flask. Python Flask is a framework that helps handle requests and student information. It also helps with scoring. This makes it easy for the front part of the system to talk to the database using EduMetric and Flask. EduMetric uses this to make sure everything works together smoothly.

For storing and managing data, this system uses Supabase, which is based on PostgreSQL. This means it can store records, like marks, attendance and how students behave in a very organized way. The system makes sure that the data is consistent, intact and secure. It also makes it easy to authenticate and access the database using Application Programming Interfaces. This is really helpful for managing records, like marks and attendance, and Supabase is what makes it all work.

The frontend is made with HTML, CSS and JavaScript. This means the frontend can be used on different platforms, and it is easy to access with a standard web browser.

For visualization we use Plotly.js. It helps us make interactive charts, graphs and dashboards. These things update by themselves when you change the view. You do not have to reload the page to see the updates. The frontend and visualization work well together to make it easy to use.

Also, Pandas and NumPy are utilized for data manipulation, aggregation, and numerical computation on the backend side. This library helps in converting raw student data into meaningful metrics that can be visualized and interpreted with ease.

V. ADVANTAGES AND APPLICATIONS

Advantages

What is really cool about EduMetric is that it is very open about how it scores things. It does not keep secrets; it shows every step of the way so everyone can see what is going on. The faculty members can see what makes up every score. When you know where the numbers are coming from, you feel like you are making decisions. EduMetric helps teachers understand why one student is doing poorly. Another student is doing well. With EduMetric, teachers can see why one learner is at risk and another learner is not. EduMetric makes it clear why some learners are struggling, and others are doing okay.

Finding problems sooner is really important. When we look at attendance data and how well students do in class and what they do at school, EduMetric finds the students who are having trouble earlier. This gives us a chance to help the students who are slipping behind, so we can slow down any bad grades they might get. EduMetric is good at spotting students who are struggling. That is a big help.

The system is really flexible. This means it can grow smoothly when things change. It works for one person or for a university. It does the thing everywhere. You do not have to change it. You need to see the information right away. The system does this with filters that you can adjust and dashboards that are for you.

When you have a lot of grading to do, it can be really tough. That is when EduMetric helps out. Teachers used to spend a lot of time looking at spreadsheets. Now they can see what is going on right away. They do not have to look at a lot of numbers because the computer makes reports for them. There are pictures and charts that show what is happening, so you do not have to guess. You get your time back because you do not have to do much paperwork. EduMetric makes it easier to make decisions because the numbers are easy to understand. The amount of work you have to do gets

smaller. You still do a good job. EduMetric really helps with grading piles.

Applications

When students move through each term, EduMetric tracks how the students are doing over time. Colleges find EduMetric helpful because EduMetric shows who might stop attending college before finishing college. Faculty members who use mentor programs get updates on individual students without waiting weeks. Seeing patterns in the students' progress on helps the faculty members guide the support for the students before the problems, with the students' progress grow too big.

When you use this setup at schools or tutoring centers it gets easier to keep track of who shows up and how students do on tests over time. You will see how the students do on tests. You will notice that some classes or departments at the schools or tutoring centres are different every year. The students and the teachers at the schools or tutoring centres will see these changes in the classes or departments.

When students need guidance, EduMetric steps in - shaping how mentors assign help like tutoring or counselling. Sometimes it's used later, during reports that check if a school meets standards or performs well overall.

VI. RESULTS AND DISCUSSION

EduMetric was tested with teachers and academic coordinators. The system grouped students based on their performance and risk level. It did this by using a scoring method. The teachers were pleased to see that the results from EduMetric were very similar to what they expected. EduMetric gives us results that are straightforward to make sense of. The teachers thought that EduMetric was able to understand the students well. EduMetric is a tool because it helps us see what is going on with the students. EduMetric is a tool that looks at how students performing and then determines what kind of help the students need. The main thing that EduMetric does is figure out how the students are doing in their schoolwork. EduMetric is used to see what the students are struggling with and what kind of help they require.

The visual dashboards were really helpful for people to understand what was happening with trends. I think they were more useful than the reports we used to get.

Faculty members could look at the dashboards and see things like when the attendance of students was going down and how that was affecting their scores.

- They could also see that the students were doing better and better over the semesters.
- The visual dashboards were also very useful for mentors because they could figure out which students needed help.
- They did this by putting the students into groups based on the risk that they were facing.
- The visual dashboards made it easier for mentors to identify the students who needed help.
- The faculty members and mentors could look at the dashboards and see what was going on with the students.

The visual dashboards were a help for the faculty members and mentors to understand the students and the trends. Mentors can help the students who really need their attention. The visual dashboards and risk categorization are tools that help mentors focus on the students who are at risk.

These tools are important because they help mentor's priorities the students. The students who are at risk need attention from mentors. Mentors can use the dashboards and risk categorization to make sure they are helping the students who need it the most.

One important observation was that heuristic scoring provided clear explainability, which is often lacking in complex predictive models. However, while the current approach performs well for classification and prioritization, future enhancements using supervised machine learning models could improve prediction accuracy for long-term outcomes such as dropouts.

VII. CONCLUSION

EduMetric is a tool that helps schools get the most out of combining information with pictures and scores that make sense.

The system does a lot more than just look at how students do on tests.

It brings together information about how students go to school, how well they do on tests, and how they behave in class, all in one simple place.

This makes it easy to see what is going on with the students and EduMetric.

EduMetric helps schools understand the students and EduMetric better so they can make decisions about what to do next, with EduMetric.

EduMetric is a system that helps people make choices. It does this by showing them information in a simple way. EduMetric gives people real-time dashboards and risk scores that are easy to understand. This is really helpful for faculty, mentors and administrators when they need to make decisions about EduMetric and the information it provides. EduMetric is about giving people the information they need to make good decisions with the help of EduMetric.

The system is really easy to work with because it is made up of parts that can be added to or changed easily. This means that EduMetric can be used by schools of all sizes from schools to big schools and even EduMetric can be used by schools with different needs. EduMetric is a choice for many schools.

EduMetric uses technologies and a special design that lets it work with other systems.

This is really helpful because EduMetric can change and grow as the needs of the school change over time. EduMetric can do this because it is made to adapt to the school's needs.

The school can use EduMetric. It will work with the other systems they have in place.

EduMetric will. Grow with the school as the school's needs change over time.

In the long run, EduMetric can serve as a foundation for intelligent academic support systems. With the integration of machine learning models, alert mechanisms, and personalized recommendations, it has the potential to transform how institutions monitor performance and support student success. Overall, EduMetric stands as a practical, scalable, and human-centered solution for modern educational analytics.

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