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Hi!ckathon 2025
Mood2Math

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1 Overview

1.1 Problem Statement

High-school students increasingly face mental-health challenges such as stress, bullying, digital addiction and unstable home environments. Yet schools lack structured, data-driven tools to detect these issues early. Most support actions are reactive and depend on self-reporting, which many students avoid due to fear, shame, or lack of awareness.

This invisibility strongly affects academic performance; particularly mathematics, where attention, emotional stability, and cognitive load play a decisive role. Without early identification, students decline academically before receiving help, leading to preventable crises, absenteeism, and even dropouts. Schools urgently need an objective, scalable system for early mental-health assessment.

1.2 Presentation of our project

We built a digital tool called **Mood2Math**, that identifies students who may be struggling with mental-health challenges. Students answer a short questionnaire covering five key areas: **stress, bullying, home environment, teacher relationship, and digital addiction**. Their answers are converted into five scores shown on a radar chart, and a simple threshold system classifies each student as Green, Orange, or Red.

When a risk is detected, the tool immediately signals the appropriate school staff, such as the psychologist, nurse, dean, or the Student Welfare and Supervision Office, so that the student is directed to the right support without delay. This provides schools with a clear, structured, and proactive way to monitor well-being and intervene early.

1.3 Presentation of the Team

Our team is composed of students from different schools across Institut Polytechnique de Paris and HEC, each bringing complementary strengths in data science, machine learning, and educational analysis. As students ourselves, we also draw on our personal observations of stress, pressure, and wellbeing challenges within the school environment. This gives us both the technical foundation and the lived experience needed to design a solution that is realistic, relevant, and meaningful for the students it aims to support.

2 Business Approach

2.1 Value of the Solution

The platform delivers value on three critical axes:

- **Saves time:** automates screening for hundreds of students, eliminating manual monitoring and freeing staff hours.
- **Saves money:** early detection reduces absenteeism, grade repetition, and dropout rates, which represent high-cost issues for schools and institutions.

- **Saves lives:** rapid identification of severe cases enables timely intervention, substantially reducing long-term mental-health risks.

By providing explainable insights (pillar-level breakdowns), the platform also improves communication among teachers, parents, and support professionals, leading to more effective interventions.

2.2 Integration into Real-World Operations

Deployment is lightweight and compatible with existing school workflows. Students complete a short questionnaire weekly or monthly. From this data, the system automatically computes pillar scores, generates the radar chart, and assigns a risk category. School staff access results through a simple dashboard showing class-level and student-level triage, and alerts automatically route Orange and Red profiles to the nurse, psychologist, or vie scolaire.

No hardware installation is required. The system runs via a web interface, integrates easily with ENT platforms, and requires minimal training.

2.3 Novelty and Differentiation

No current tool in French high schools offers centralized, predictive, and explainable mental-health monitoring. Existing platforms such as PRONOTE and École Directe manage grades, attendance, and administrative tasks, but none provide wellbeing analytics, early-risk detection, or structured triage toward support staff. As a result, schools intervene late, inconsistently, and often only after academic decline or crisis.

We fill this gap by creating the missing equivalent of a "mental-health gradebook", built around:

- Objective scoring through five key well-being pillars (stress, bullying, digital dependency, home environment, teacher trust)
- Transparent threshold-based classification (Green/Orange/Red)
- Automated routing to the nurse, psychologist, or the Student Welfare and Supervision Office
- Real-time dashboards for teachers and administrators.

There is a clear gap in the French EdTech market, and no current tool combines mental-health monitoring, pillar-level explainability, and automatic support activation. Our solution provides the missing infrastructure for early, coordinated, and data-driven intervention inside high schools.

2.4 Business Model and Cost Structure

We adopt the same monetization logic as major French EdTech platforms such as PRONOTE and École Directe: a single annual license paid by the school.

Annual license: 1000 € per school

The license includes: questionnaires, five-pillar scoring, radar visualization, threshold-based triage, crisis alerts, and ENT integration. This pricing is aligned with typical digital tool budgets in French high schools.

The model also scales to institutional contracts. An académie or regional authority can equip all its high schools through a single agreement, representing **150,000 € – 450,000 €** per year depending on the number of schools. This ensures accessibility at the school level and strong scalability at the national level.

3 Scientific approach

3.1 Scientific Foundation: Math Score Prediction

To validate the theoretical foundation of Mood2Math, we first aimed to predict students' *MathScore* using PISA-like survey data. This supervised regression task served to quantify the impact of well-being on academic results, utilizing Root Mean Squared Error (RMSE) as the evaluation metric.

Data Preparation & Feature Engineering We processed the dataset by merging training and testing sets for exploration while preserving the original split. Missing values were handled via median imputation for numeric features and mode imputation for categorical ones; special codes (e.g., 97, 98, 99) were mapped to NaN. To ensure model robustness, we addressed multicollinearity by computing the Pearson correlation matrix. For pairs with $|r| > 0.9$, we retained only the feature with the highest mutual information relative to the target, resulting in a compact, highly informative feature set.

Modelling Strategy We benchmarked baselines (Mean predictor, Ridge/Lasso) against advanced tree-based ensembles (RandomForest, XGBoost, CatBoost). After comparing several algorithms, XGBoost and CatBoost obtained the best RMSE on the validation set. Instead of keeping a single model, we built an ensemble by aggregating (averaging) the predictions of XGBoost and CatBoost in order to gain stability and a small performance boost. Both models are tuned gradient-boosting trees (with a few hundred trees, small learning rate and regularization to limit overfitting).

Explainability & Impact Beyond prediction, the model serves as a validation tool for our hypothesis. Feature importance analysis revealed that alongside classical drivers (prior achievement, study time), **well-being proxies**—such as math self-confidence, test anxiety, and sense of belonging—are critical predictors. This confirms that low performance is often a symptom of underlying distress, justifying the operational structure of the Mood2Math tool described below.

Our method transforms student questionnaire responses into five well-being indicators: **Stress**, **Bullying**, **Home Environment**, **Teacher Relationship**, and **Digital Addiction**. These pillars capture the main factors affecting mental health and academic performance.

3.2 Questionnaire and Pillar Structure

Each question is assigned to one of the five pillars. Students answer a short survey, and every response contributes directly to the score of the corresponding pillar. For each question, we predefined a weight, with all weights within a pillar summing to 100. A positive answer (indicating a difficulty) adds the weight to the pillar's score; a negative answer adds zero. This produces five pillar scores between 0 and 100.

Stress	**Bullying**	**Digital Addiction**	**Home Environment**	**Teacher relationship**
WB154 (20)	ST038 (25)	IC177 (20)	ST258 (20)	ST267 (20)
WB155 (20)	ST266 (15)	ST322 (20)	PA042 (20)	ST212 (20)
WB176 (15)	ST097 (15)	IC180 (15)	WB163 (15)	ST102 (15)
WB177 (15)	ST273 (15)	IC170 (15)	ST300 (15)	ST211 (15)
WB168 (15)	ST034 (15)	IC174 (15)	PA003 (15)	ST352 (15)
WB166 (15)	WBA8 (15)	ST349 (15)	ST230 (15)	ST290 (15)

Table 1: Question codes grouped by wellbeing pillar, based on PISA Glossaire

3.3 Threshold Classification

We use simple and transparent thresholds:

- **Green:** Safe zone, less than 2 features exceed the Warning Threshold (40).
- **Orange:** Triggered if more than 2 features exceed the Warning Threshold (40).
- **Red:** Triggered if at least 1 feature exceeds the Critical Threshold (70) AND at least 2 features exceed the Warning Threshold.

When a threshold is crossed, the entire radar chart adopts the corresponding color, making interpretation immediate.

3.4 Automatic Routing to Support Staff

Each pillar is associated with the appropriate school resource.

- High stress levels lead to follow-up with the psychologist.
- Bullying concerns are handled by the dean, the psychologist, or the nurse.
- Home environment difficulties are managed by the Student Welfare and Supervision Office, which can provide a quiet workspace and daily support.
- Teacher–student relationship issues are addressed collectively by the class council or teaching team.
- Digital addiction concerns are supported by the psychologist or nurse.

This mapping ensures that every alert immediately identifies who should intervene and why.

3.5 Visualisation

The five scores are displayed on a radar chart, making difficulties visible at a glance. Staff can instantly see which pillar triggered the alert and how severe the situation is.

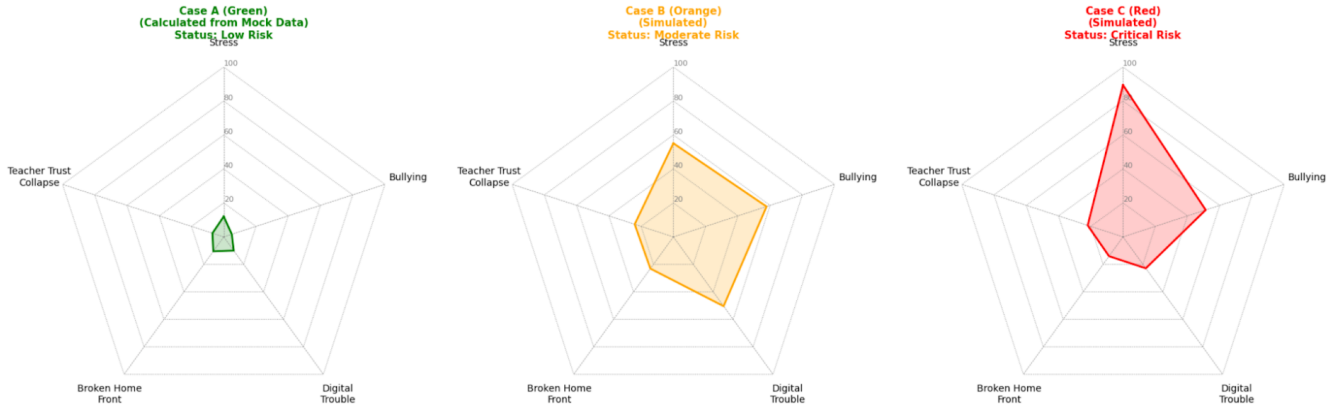

Figure 1: Three simulated student wellbeing profiles produced by Mood2Math, illustrating Green (low risk), Orange (moderate risk), and Red (high risk) classifications based on the five-pillar scoring system.

4 Results and Future Potential

Mood2Math already produces clear, interpretable results: the five-pillar scoring highlights the source of each difficulty, the radar chart visualizes it instantly, and the Green–Orange–Red thresholds make classification fully explainable for staff. In testing, the system consistently identified high-stress or bullying cases and routed them to the correct support personnel without delay.

The platform also has strong potential for wider deployment. It can include long-term tracking, weekly wellbeing reports, and full integration with ENT systems to simplify adoption. Beyond high schools, the same scoring and triage method applies naturally to middle schools and universities. At a broader scale, an académie or regional authority could deploy Mood2Math across all its institutions, generating anonymized wellbeing indicators and early-warning signals for entire regions. This would give education authorities a clear and unified picture of student wellbeing.

The approach is not limited to high schools. The same scoring and triage method applies naturally to middle schools, and universities. With this scalability, the platform can become a standard tool for preventive mental-health monitoring across the whole education system.