

SMART SCHOOL MANAGEMENT APP

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1. Introduction

Background and motivation:

The traditional methods for managing schools, which rely on manual processes, are time-consuming, error-prone, and inefficient. Tasks such as tracking attendance, grading, and evaluating performance are often delayed, which affects both administrative operations and student outcomes. Thanks to advancements in artificial intelligence (AI), there is now a significant opportunity to transform education. AI can automate routine tasks, analyse data in real time, and provide insights that support better decision-making. This not only streamlines administrative processes but also enhances teaching, learning, and communication among all stakeholders, thereby motivating the development of AI-driven school management systems to overcome these challenges.

Problem Statement:

The traditional methods of managing school operations often involve manual processes, which are slow and prone to errors. This inefficiency leads to delayed feedback for both students and teachers, making it difficult to address issues as they arise. Performance tracking, whether for academic progress or teacher evaluations, lacks real-time data. Without automated systems, schools struggle to gather, analyse, and act on performance metrics efficiently. To overcome these challenges, schools require real-time systems that can continuously monitor and assess both student and teacher performance, enabling faster and more effective decision-making.

Scope of the Report:

This project aims to create an AI-driven school management system. It will involve developing a user interface for both teachers and students, integrating AI algorithms for data analysis and report generation, and establishing a sustainable revenue model. The project also includes addressing potential challenges and proposing solutions to ensure the system's effectiveness and scalability.

2. Prototype selection

Feasibility:

Technical Feasibility: Leveraging existing AI and machine learning technologies, we can develop the app with robust performance tracking and data analytics capabilities.

Development Timeline (1-2 years): The app's development will span 2-3 years, beginning with core features like attendance tracking and feedback systems. In later phases, advanced AI capabilities, including predictive analytics, will be integrated to enhance performance tracking and decision-making.

Viability:

Market Trends and Long-Term Relevance: The demand for AI-driven educational technology (EdTech) solutions is projected to rise significantly over the next 20-30 years as schools increasingly adopt digital platforms. Core trends like remote learning and data-driven insights will continue to shape the education landscape, making AI solutions essential for future growth.

Adaptability to Future Educational Needs: The app will evolve with the educational sector by incorporating the latest AI models, ensuring it remains relevant and effective. It will consistently provide personalized learning experiences and real-time feedback, addressing the changing needs of students and educators.

Monetization:

Direct Revenue Models: The app will follow a subscription-based pricing model for schools, offering tiered packages that grant access to different features depending on the school's needs. This allows institutions to choose the level of service that suits their budget while scaling the app's functionality as required.

Comparison with Indirect Monetization: In addition to subscriptions, the app can generate revenue through advertisements and partnerships with educational content providers, offering schools additional resources while creating an income stream. This indirect model adds flexibility by allowing free or lower-cost access, supplemented by ads or sponsored content.

3. Market Research and Analysis

Market Need Assessment:

- Schools are increasingly adopting AI-driven tools to enhance administrative efficiency and improve learning outcomes.
- The growing demand for remote learning and real-time insights highlights the need for AI-based school management systems.
- There is a rising emphasis on data-driven decision-making to improve student performance and optimize resource allocation.

Target Market Identification

- The primary target market includes K-12 schools and educational institutions that require real-time data for effective decision-making.
- Secondary targets are tech-savvy schools looking to enhance communication between teachers, students, and parents through modern digital platforms.

Competitor Analysis

- ClassDojo: Focuses on classroom communication, allowing teachers to share updates with parents and students. However, it lacks advanced AI-driven performance tracking.
- Schoology: Provides a comprehensive learning management system (LMS) with tools for creating and managing assignments, but its focus is more on content delivery than on teacher and student performance evaluation.
- Edmodo: Offers tools for classroom management and parent communication, but does not emphasize AI-based analysis and reporting.

Full dataset link - [Github](#)

	CompetitorID	CompetitorName	FeatureSet	PricingModel	UserRating	MarketShare	KeyStrengths	KeyWeaknesses	OverallScore
0	1	EduManagePro	Attendance, Reporting	Freemium	4.4	16%	Robust reporting, Easy integration	High cost, Limited customization	6.6
1	2	SmartEduApp	AI-Powered Assessment	One-time Purchase	3.3	12%	AI-driven insights, Affordable	Limited support, Basic features	7.5
2	3	SchoolMate	Behavior Tracking, Admin	Freemium	3.6	19%	Comprehensive features, Low cost	Outdated UI, Poor customer support	6.2
3	4	ClassTrack	Timetable Management, Parent Portal	Subscription	5.0	13%	User-friendly, Scalable	Limited third-party integrations	8.1
4	5	EduHub	Learning Analytics, Gamification	One-time Purchase	4.4	18%	Engaging, Data-driven	Complex setup, Requires training	8.3

Customer Segments

- School Administrators: Focus on leveraging data-driven insights for decision-making, improving school operations, and optimizing resources.
- Teachers: Benefit from performance feedback, real-time student monitoring, and tools to enhance classroom engagement and instruction.
- Parents: Desire real-time, detailed reports on their children's academic and behavioral performance, helping them stay actively involved in their child's education.
- Students: Seek consistent performance tracking and personalized feedback on areas such as behaviour, punctuality, and academic progress, helping them stay accountable and improve their performance.

4. Prototype Development

Development Methodology:

When creating a smart school management system, it is crucial to follow a structured approach. Here are the steps you should consider:

1. Ideation and Market Research:

- Understand the needs of educational institutions.
- Research existing solutions and identify gaps.
- Define the scope and objectives of your system.

2. Budgeting and Monetization Plan:

- Estimate development costs.
- Decide on a monetization strategy (e.g., subscription-based, licensing).

3. Select the Right Development Team:

- Project Manager: Oversees the project and coordinates between teams.
- Frontend Developers: Design and develop the user interfaces.
- Backend Developers: Implement server-side logic and database management. Data Scientists/AI Engineers: Develop and integrate AI algorithms.
- QA Engineers: Conduct testing to ensure the system is robust and bug-free. UI/UX Designers: Ensure the user interfaces are intuitive and user-friendly

4. User Interface (UI) and User Experience (UX) Design:

- Development of a mobile and web-based user interface (UI) to ensure accessibility for teachers, students, parents, and administrators.
- Key Features: Secure login, personalised dashboards, user profile management, feedback system, and real-time notifications.
- Back End Development: Establishing a robust database schema to securely store user data, attendance records, and performance metrics.
- Integrating AI algorithms for attendance tracking, performance analysis, and feedback processing.
- Development of RESTful APIs to facilitate communication between the front end and back end.

5. Core Development and Quality Assurance (QA):

- Develop the system's core features (e.g., attendance tracking, student records).
- Rigorously test the system for functionality, security, and performance.

6. Launch the Minimum Viable Product (MVP):

- Release an initial version with essential features.
- Gather user feedback for further improvements.

7. Marketing and Promotion:

- Promote your system to educational institutions.
- Highlight its benefits and unique features.

Technology Stack:

- The technology stack for a smart school management system can vary, but here's a common choice:

- Frontend: React.js or Angular for building the user interface, HTML, CSS, JavaScript for building user interfaces.
- Backend: Node.js or Django for server-side logic.
- Database: MongoDB or PostgreSQL for data storage.
- AI and Machine Learning: Python for developing AI algorithms. Libraries such as Pytorch, TensorFlow, Keras, and Scikit-learn for machine learning models.
- Authentication: OAuth or JWT for secure user authentication.
- Cloud Services: AWS or Azure for scalability and reliability.

AI Model Development:

1. Data Collection and Preprocessing:

Collect real-time data on student performance, teacher’s attendance, and behaviour. Preprocess the data to handle missing values, outliers, and inconsistencies. The project makes use of 3 datasets i.e., StudentsPerformance.csv, teacher_performance_evaluation.csv, smart_school_app_competitors.csv.

Teacher performance evaluation dataset:

	Teacher_ID	Gender	Race/Ethnicity	Highest Level of Education	Years of Experience	Subject	Punctuality Score	Student Feedback Score	Class Performance Score	Teacher Attendance Rate
0	T001	Female	Group B	Master's degree	8	Mathematics	95	4.8	85	0.98
1	T002	Male	Group C	Bachelor's degree	5	Science	90	4.6	80	0.95
2	T003	Female	Group A	Bachelor's degree	10	English	88	4.5	78	0.93
3	T004	Male	Group D	Master's degree	12	History	92	4.7	82	0.96
4	T005	Female	Group B	Associate's degree	3	Geography	85	4.3	75	0.92

Student Performance dataset:

	gender	race/ethnicity	parental level of education	lunch	test preparation course	math score	reading score	writing score
0	female	group B	bachelor's degree	standard	none	72	72	74
1	female	group C	some college	standard	completed	69	90	88
2	female	group B	master's degree	standard	none	90	95	93
3	male	group A	associate's degree	free/reduced	none	47	57	44
4	male	group C	some college	standard	none	76	78	75

You can follow the [link](#) for the dataset analysis and to get the important insights from the data

Based on the insights from the collected datasets our smart AI will generate this kind of report

NLP Report by the overall teacher performance in the XYZ School:

****Teacher Performance Report: XYZ School****

****Summary of Findings:****

The average punctuality score among teachers is 88.17, with a median score of 88.0 . The average student feedback score is 4.40, showing that students generally have positive feedback about their teachers . The class performance scores average at 81.13, suggesting that the overall student performance is good but has room for improvement .

****Detailed Insights:****

1. ****Punctuality:**** The average punctuality score is 88.17, with teachers showing consistent timeliness.
2. ****Student Feedback:**** Teachers receive an average feedback score of 4.40, indicating positive student interactions.
3. ****Class Performance:**** The average class performance score is 81.13, suggesting a need for targeted improvements.
4. ****Teacher Attendance:**** High attendance rates with an average of 0.93%.

****Correlations and Insights:****

- Positive correlation between punctuality and feedback scores.
- Moderate correlation between professional development and class performance.

****Recommendations:****

- Encourage continued professional development to enhance class performance.
- Focus on maintaining high punctuality as it correlates with positive student feedback.
- Implement targeted strategies to improve overall class performance scores.

Figure 1- Generate a Narrative using NLP: Using the Hugging Face transformers library, we employ the summarization pipeline to convert the insights into a concise summary.

Sample AI Generated report for the specific teacher:

****Teacher Performance Report for T001****

****Summary of Findings:****

The teacher's attendance rate is higher than the average attendance rate of 0.93% . The teacher is above the overall average of 81.13% and is above average punctuality . The student feedback from students is positive, according to the teacher's report .

****Detailed Insights:****

Teacher Report for T001 - Mathematics

****Overview**:**

- Gender: Female
- Race/Ethnicity: Group B
- Highest Level of Education: Master's degree
- Years of Experience: 8
- Subject: Mathematics

****Punctuality**:**

- Punctuality Score: 95
- Compared to the average punctuality score of 88.17, this teacher is above average.

****Student Feedback**:**

- Student Feedback Score: 4.8
- Compared to the average feedback score of 4.40, the feedback from students is positive.

****Class Performance**:**

- Class Performance Score: 85
- The class performance is above the overall average score of 81.13.

****Attendance**:**

- Attendance Rate: 0.98%
- The teacher's attendance rate is higher than the average attendance rate of 0.93%.

Sample AI generated Report for the specific student from the collected data

****Student Performance Report****

****Summary**:**

Gender: female; Race/Ethnicity: group B; Parental Education: bachelor's degree; . Parents: none; . Reading and writing scores: 72; . Writing score: 74; . Math score: 72 - above the overall average of 66.09.09 .

****Detailed Insights**:**

Student Report for female student from group B

****Overview**:**

- Gender: female
- Race/Ethnicity: group B
- Parental Education: bachelor's degree
- Lunch Type: standard
- Test Preparation Course: none

****Scores**:**

- Math Score: 72
 - The student's math score of 72 is above the overall average of 66.09.
- Reading Score: 72
 - The reading score of 72 is above the overall average of 69.17.
- Writing Score: 74
 - The writing score of 74 is above the overall average of 68.05.

****Analysis**:**

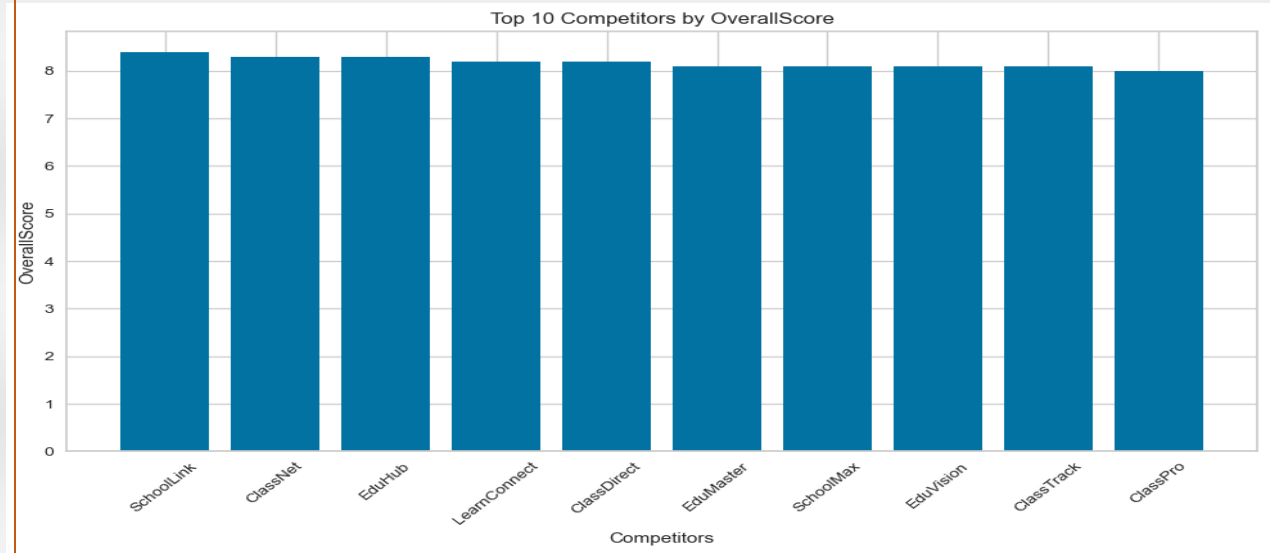
- This student did not participate in a test preparation course.
- Students with a bachelor's degree typically perform better in math.

Competitor Analysis:

Dataset:

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Figure - Overall score of 10 competitors



2.

Machine Learning Algorithms:

- Used algorithms for personalized recommendations (e.g., suggesting relevant courses or resources).
- Implemented natural language processing (NLP) for chatbots or automated communication.
- Applied predictive analytics for early intervention (e.g., identifying at-risk students). To predict the preference of students to take courses for test preparation.

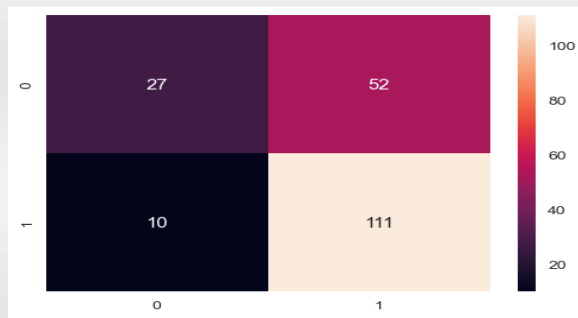
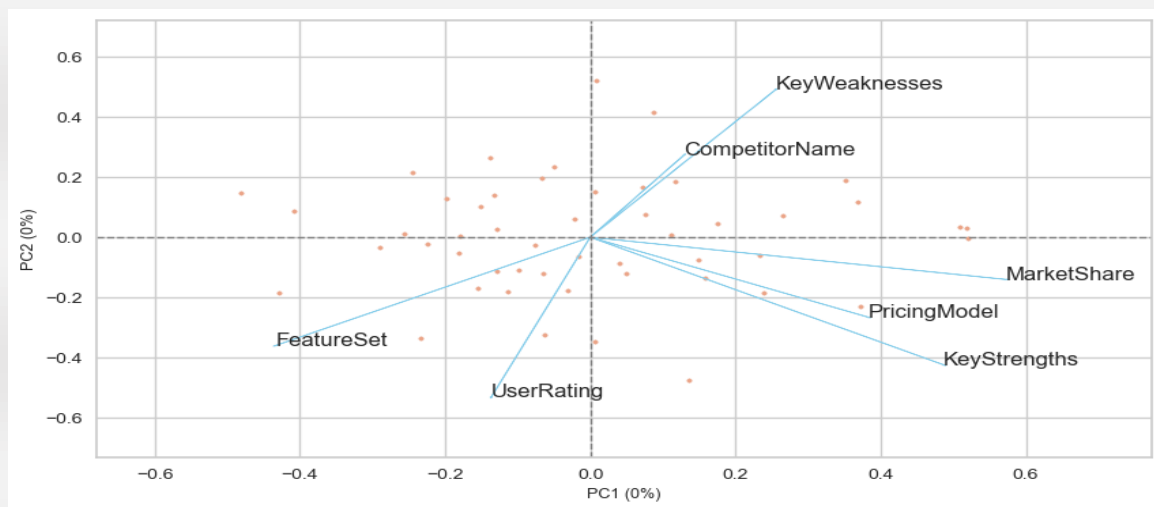
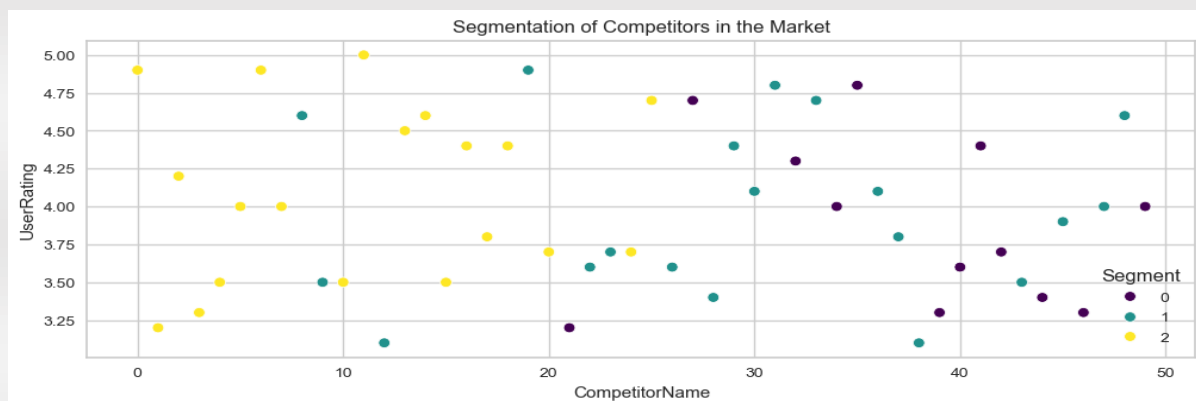


Figure - Modelling and evaluation using logistic regression.



Principle Component score.



5. BUSINESS MODELLING

Value Proposition

Our School Management AI System offers a comprehensive and intelligent platform designed to streamline school operations, enhance the learning experience, and foster stronger connections between educators, students, and parents. By leveraging advanced AI technology, we provide a suite of features that not only automate routine administrative tasks but also provide actionable insights to drive decision-making and improve overall educational outcomes.

Free Tier:

Features:

- Basic Punctuality Tracking: Manual logging of teacher attendance.
- Basic Student Feedback: Simple feedback form for students with limited questions.
- Basic Performance Assessment: Limited AI-powered reports on teacher performance and class engagement.
- Basic Student Grading: Standard grading features for behaviour and performance.
- Ad-supported: Display relevant educational ads within the app.

Benefits

- Attracts a large user base by offering essential features for free.
- Allows schools to experience the app's core functionality with no initial investment.

Basic Subscription Plan:

Features:

- Advanced Punctuality Tracking: Automated attendance reminders and reports.
- Enhanced Student Feedback: Expanded feedback forms with more detailed questions.
- Detailed Performance Assessment: More in-depth AI-generated performance reports with actionable insights.
- Enhanced Student Grading: More comprehensive grading metrics and reports.
- Ad-Free Experience: Option to remove ads.
- Support and Training: Basic customer support and access to introductory training materials.
- Pricing: \$X per school per month.

Benefits:

- Provides more comprehensive features and removes ads, offering a better user experience.
- Generates steady revenue from schools that want improved functionality without advanced features.

Premium Subscription Plan:

Features:

- Comprehensive Punctuality Tracking Advanced analytics and predictive insights on attendance trends.
- Customizable Student Feedback: Tailor feedback forms to specific needs and subjects.
- Advanced Performance Assessment: In-depth analysis with personalized recommendations and benchmarking against peers.
- Personalized Student Reports: Detailed AI-driven reports with personalized learning paths and recommendations.
- Exclusive Educational Resources: Access to premium study materials and additional resources.
- Priority Support: Dedicated support with fast response times and personalized assistance.
- Integration Support: Seamless integration with existing school management systems and third-party tools.
- Pricing: \$Y per school per month.

Benefits:

- Offers advanced features and personalized support for schools that need more sophisticated tools.
- Creates additional revenue opportunities through premium features and services.

Additional Revenue Streams:

1. Commission on Tutoring Services:

Implementation: Partner with tutors and recommend their services through the app. Earn a commission on tutoring fees.

Benefit: Adds a revenue stream while providing value-added services for students.

2. Commission on Study Materials:

Implementation: Promote and sell study materials through the app, earning a commission on sales.

Benefit: Provides useful resources for students and generates additional income.

3. Custom Integration Fees:

- Implementation: Charge for custom integration with existing school systems or third-party tools.

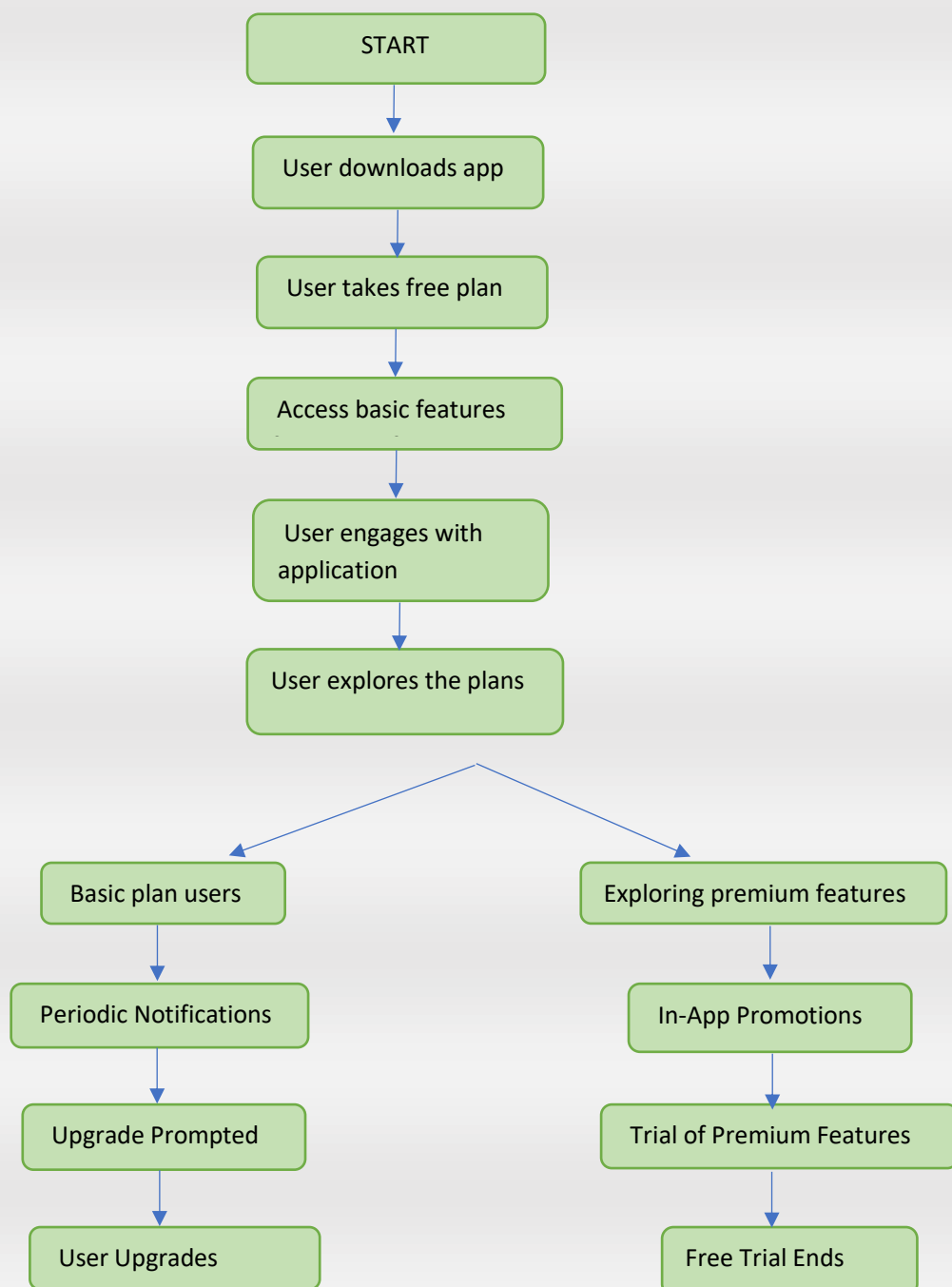
- Benefit: Generates revenue from schools needing tailored solutions.

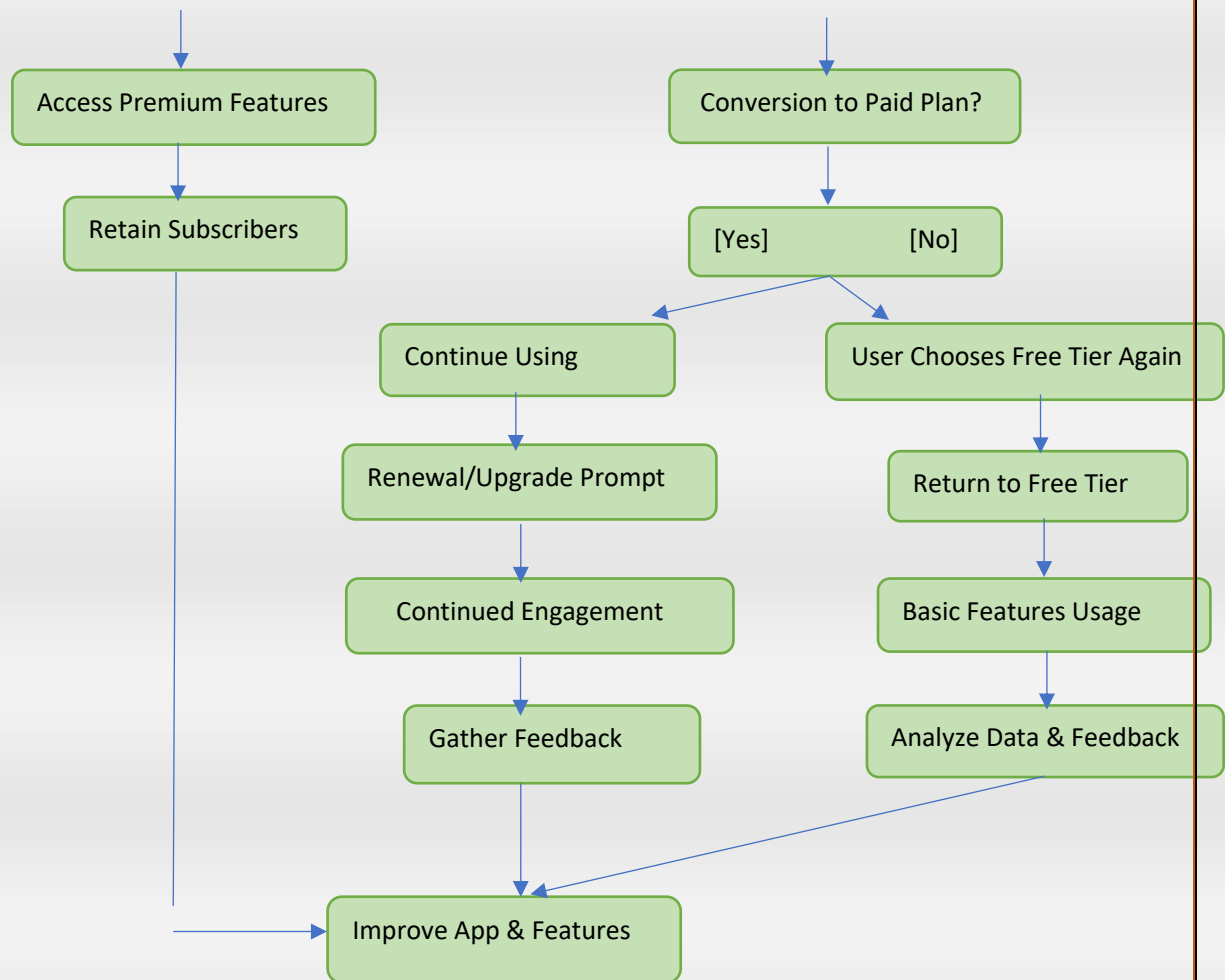
Why This Model Works:

1. Accessibility: The free tier ensures broad accessibility and allows schools to try the app with no initial cost, increasing user acquisition.
2. Upsell Opportunities: The tiered subscription plans provide clear pathways for schools to upgrade as their needs grow, enhancing revenue potential.
3. Additional Revenue: The model incorporates various revenue streams beyond subscriptions, diversifying income sources and increasing overall profitability.

By offering a strong base of features for free and additional value through tiered plans, this business model attracts a wide range of schools while generating sustainable revenue.

Flowchart diagram:





Data Privacy and Security

- **Overview:** Ensure compliance with data privacy regulations like GDPR (General Data Protection Regulation), COPPA (Children's Online Privacy Protection Act), and FERPA (Family Educational Rights and Privacy Act) to safeguard student, teacher, and parent data.
- **Security Protocols:** Implement robust encryption, multi-factor authentication, and regular security audits to protect sensitive data. Ensure data storage is compliant with international standards.
- **Data Management:** Outline how personal data will be handled, stored, and shared securely while giving users control over their information (opt-in/opt-out mechanisms).

Education Laws and Regulations

- **Compliance:** The platform must comply with national and local educational laws and regulations concerning student records, attendance, and teacher evaluations.
- **Accessibility:** Ensure the app adheres to accessibility standards like the ADA (Americans with Disabilities Act) to make education inclusive.
- **Licensing and Certification:** Address any legal requirements for software used in educational environments, including certification processes and licensing fees for

education institutions.

Ethical Considerations in AI Usage

- **Bias and Fairness:** Develop algorithms that are unbiased and inclusive, ensuring that AI decisions (e.g., grading, attendance tracking) are transparent, explainable, and do not perpetuate discrimination.
- **Student and Teacher Autonomy:** Ensure that AI recommendations and tools empower rather than replace human decision-making, maintaining accountability for teachers and administrators.
- **Consent for AI Usage:** Obtain explicit consent from users before collecting data for AI processing, and provide transparent explanations of how AI is being used.

6. Financial modelling

Market size potential

The market size for a smart school management system includes schools, universities, and educational institutions. Estimating the number of potential customers and their spending capacity helps determine revenue. The market potential is the maximum achievable revenue as institutions adopt digital tools for administrative purposes

Revenue Forecasting

Pricing strategy: Set a tiered pricing model based on the institution's size and service needs. For example, small schools might pay \$1,000 annually, while large institutions may pay up to \$50,000.

Sales projection: Estimate the number of clients and revenue growth by year based on market trends and product demand.

Cost Analysis

Development and maintenance cost: Initial development, ongoing system maintenance, and updates are critical cost factors.

Marketing and operational cost: Include expenses related to customer acquisition, onboarding, and day-to-day operations.

Financial Projections

Profit and loss statement: Project revenue, costs, and profit to assess the system's financial health.

Break even analysis: Determine the number of sales needed to cover all costs.

Financial Equations and Models

Linear and Exponential Growth Models: Use linear growth for steady markets and exponential models for fast-growing ones. For linear: $y=mx+c$. For exponential: $y=m \cdot Ae^{kt}+c$

Financial equation

1. Linear Financial Model:

In a linear financial model, total profit (y) increases linearly with time based on the sales of the product and associated costs.

Linear Equation: $Y = m \cdot x(t) + c$

- y = total profit
- m = pricing of the product (profit per unit sold)
- $x(t)$ = total sales (market as a function of time, could be the number of units sold)
- c = fixed costs (e.g., production, maintenance, etc.)

Example:

Let's assume:

- $m = \$100$ (profit per unit)
- $x(t) = 500$ units sold per month (increases by 500 each month)
- $c = \$50,000$ (fixed costs)

For any given time t , say $t=5$ months:

$$x(t)=500 \times t=500 \times 5=2500 \text{ units sold by month 5}$$

Thus, the linear model for profit at $t=5$ is:

$$y=100 \cdot 2500+50000=250000+50000=300000$$

So, after 5 months, the total profit is \$300,000.

2. Exponential Financial Model (Market Growing Exponentially):

In an exponential financial model, the total sales are modelled as growing exponentially over time, typically due to increasing demand.

Exponential

Equation:

$$y = m \cdot x(t) + c$$

Where:

- $x(t) = A \cdot e^{kt}$
- A = initial sales (e.g., at $t=0$)
- e = base of natural logarithms
- k = growth rate of sales (exponential growth factor)

Example:

Let's assume:

- $m=100$ (profit per unit)
- $A=500$ units (initial sales at $t=0$)
- $k=0.2$ (20% growth rate per month)
- $c=50000$ (fixed costs)

For $t=5$ months:

$$x(t) = 500 \cdot e^{0.2 \cdot 5} = 500 \cdot e^1 = 500 \cdot 2.718 = 1359 \text{ units sold by month 5}$$

Thus, the exponential model for profit at $t=5$ is:

$$y = 100 \cdot 1359 + 50000 = 135900 + 50000 = 185900$$

So, after 5 months, the total profit is \$185,900.

Calculation:

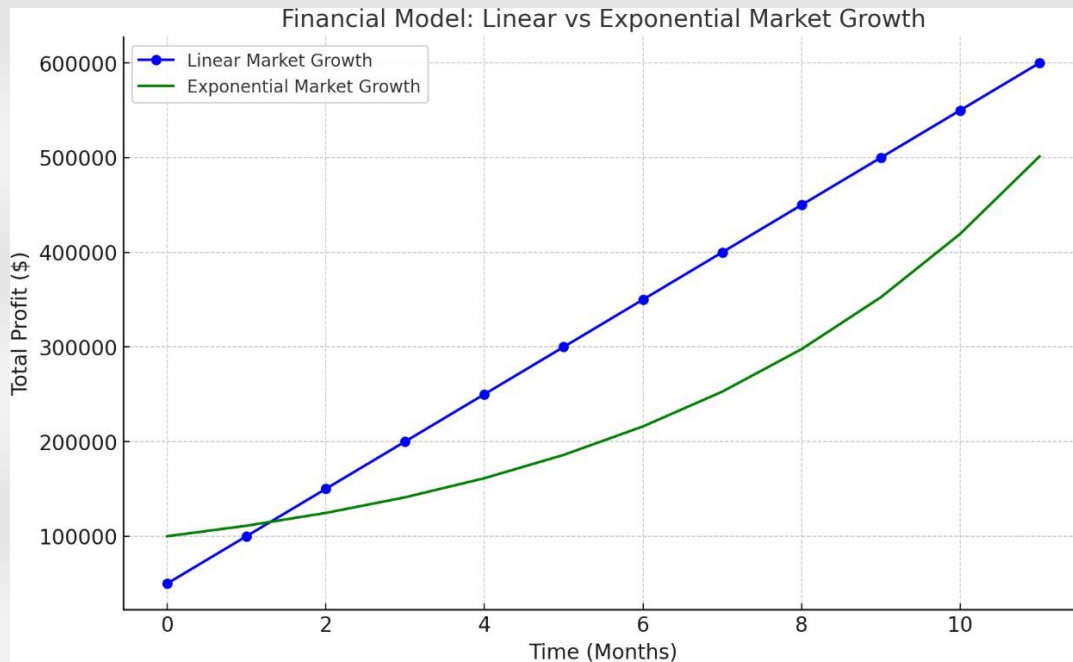
Let us calculate the exact results using Python for both models.

For 5 months of sales:

- **Linear Model:** The total profit is \$300,000.
- **Exponential Model:** The total profit is approximately \$185,914.

These results highlight the difference between a market growing linearly versus exponentially over time. The linearmodel shows consistent growth, while the exponential model shows initially slower growth but has the potential formuch faster increases over longer periods.

FINANCIAL MODEL: LINEAR VS EXPONENTIAL MARKET GROWTH



Here is the visual representation of the financial models:

- The **blue line** represents the **linear market growth**, where total profit increases steadily over time.
- The **green line** shows the **exponential market growth**, where the total profit starts slower but grows rapidly over time.

The graph highlights the difference between linear and exponential market growth trends for the smart school management system.

Final Thoughts:

The **Smart School Management App** has the potential to revolutionize school operations by providing a platform that adapts to the evolving needs of educational institutions. Its focus on AI integration, data security, and continuous improvement positions it as a transformative tool for schools. By implementing the recommended next steps, the app can continue to grow in functionality and relevance, ultimately becoming an indispensable part of modern education systems.

For the coding part please follow this link- [mrorobot/Smart-School-Management-app-project: Smart School Management App - AI-Driven Student and Teacher Evaluation Welcome to the Smart School Management App, an AI-powered platform designed to enhance the evaluation process for both students and teachers. \(github.com\)](https://github.com/mrorobot/Smart-School-Management-app-project)

