

1. Teacher Features

Feature	Example	Technology
Dashboard	"Physics 2025 AL – 320 students active this week"	React.js, NestJS, MongoDB, Redis
Student Management	"Add 45 students to Chemistry Revision Batch"	React.js, NestJS, MongoDB
Batch Management	"Create batch: Physics 2025 AL – Weekday Class"	React.js, NestJS, MongoDB
MCQ Exam Management	"A/L Biology – Plant Cells MCQ Test (40 mins)"	React.js, NestJS, MongoDB
Question Bank Management	"Lesson: Organic Chemistry – Alcohols (Hard)"	React.js, NestJS, MongoDB, Redis
Short Answer Upload	"Explain Keynesian Theory (10 marks)"	React.js, NestJS, MongoDB
Notes / Theory Upload	"Download: Physics – Motion & Forces Summary (PDF)"	React.js, NestJS, AWS S3 / Firebase Storage
Recorded Classes / Videos	"Chemistry – Electrolysis Revision Class (Recording)"	React.js, NestJS, AWS S3 / Vimeo / YouTube unlisted
Anti-Cheating Controls	"Exam ends if student leaves app 3 times"	NestJS, WebSockets, Redis
Analytics & Reporting	"70% of students scored low in Organic Chemistry – Lesson 3"	React.js, NestJS, MongoDB, Chart.js / Recharts
Announcements / Messaging	"Reminder: Today's Online Class at 7 PM"	React.js, NestJS, Firebase Cloud Messaging
Payment Management	"45 students pending payment for January"	Stripe / eZ Cash API, NestJS, MongoDB
Branding / White-Label	"App shows teacher's logo SMART ACADEMY – Sir Kavishka"	React.js, NestJS, MongoDB, AWS S3

2. Student Features

Feature	Example	Technology
Student Login & Profile	"Logged in as Nimesh – Physics 2025 AL Batch"	React Native, NestJS, MongoDB, JWT
Join Batches	"Enter code: PHY2025-SAT"	React Native, NestJS, MongoDB
Take MCQ Exams	"O/L Science – Chapter 04 MCQ (25 mins)"	React Native, NestJS, MongoDB
View Results & Feedback	"You spent 12 seconds on Question 5"	React Native, NestJS, MongoDB
Access Notes & PDFs	"Download: Accounting – Ledger Notes (PDF)"	React Native, AWS S3 / Firebase Storage
Watch Recorded Lessons	"Watch: Organic Chemistry – Alcohols Explained"	React Native, AWS S3 / Vimeo / YouTube unlisted
Daily Quiz Mode	"Day 7 streak! +25 XP"	React Native, NestJS, MongoDB, Redis
Leaderboards & Rankings	"Rank #4 in Physics Weekly Challenge"	React Native, NestJS, Redis, MongoDB
Student Analytics	"Weak topic: Combined Maths – Differentiation"	React Native, NestJS, MongoDB, Chart.js
Announcements & Notifications	"Exam starts in 10 mins"	React Native, NestJS, Firebase Cloud Messaging

3. Other / System Features

Feature	Example	Technology
Multi-Tenant SaaS	"Teacher A and B use same system but separate data"	NestJS, MongoDB, Redis
Super Admin Panel	"Deactivate one teacher for violating policies"	React.js, NestJS, MongoDB
Billing & Subscription	"Starter Plan: max 200 students → Rs. 5,000/month"	Stripe / eZ Cash API, NestJS, MongoDB
White-Labeling System	"Sir Chamika's app shows his branding"	React.js, NestJS, MongoDB, AWS S3
UI/UX Customization	"Theme color per teacher, logo upload"	React.js, React Native, NestJS
Security & Audit Logs	"Student attempted to switch apps during MCQ"	NestJS, MongoDB, Redis

Feature	Example	Technology
Backup & Cloud Storage	"PDFs, videos, images backed up"	AWS S3 / Firebase, MongoDB backup
Scalability Architecture	"Add unlimited teachers & students"	NestJS, MongoDB, Redis, Load Balancer

4. Technology Stack Summary

Layer	Technology	Notes
Mobile App	React Native	Cross-platform iOS & Android student app
Teacher Dashboard	React.js	Web dashboard
Backend API	Node.js + NestJS (Fastify)	Multi-tenant SaaS, scalable, structured
Database	MongoDB + Redis	Stores students, batches, exams, caching
File Storage	AWS S3 / Firebase Storage	PDFs, images, lesson videos
Payments	Stripe / eZ Cash	Subscription & payment management
AI / Auto-mark	Python + OpenAI API	Optional premium add-on
Hosting	Render / AWS / Vercel	Backend + Web dashboard
Load Balancer	Nginx / Cloud LB	Handle 100+ concurrent students
Notifications	Firebase Cloud Messaging	Push notifications for mobile app

5. Scalability & Load Handling

- Horizontal scaling: multiple NestJS instances behind load balancer
- Redis caching: question banks, leaderboards, session data
- Stateless APIs: exam sessions in DB/Redis, not memory
- WebSocket scaling: Redis Pub/Sub
- Database indexing: Student ID, Batch ID, Exam ID

6. Advantages & Disadvantages

Advantages: - High market demand in Sri Lanka tuition sector - Scalable SaaS: multiple teachers, recurring revenue - Automatic MCQ grading → teacher time saved - Analytics & reports → engagement & retention - White-labeling & branding → premium selling point - Low operational overhead initially

Disadvantages / Challenges: - Initial development complexity is high - Teacher onboarding requires trust & demo - Short-answer marking can be time-consuming (manual) - Competition exists

(StudyMaster, BrightUp, etc.) - Maintenance, updates, cloud costs for production - Payment & legal compliance needed

7. Free Development Stack / Tools

Layer	Free Tool / Tier	Notes
Mobile App	React Native + Expo	Test on simulators / phones
Web Dashboard	React.js + Vercel / Localhost	Free hosting for dashboard
Backend	NestJS + Node.js	Run locally / free cloud tier
Database	MongoDB Atlas Free	500MB storage, 100 connections
Cache	Redis Open Source	Local dev or free cloud tier
File Storage	Firebase / AWS Free Tier	1-5 GB storage
Payments	Stripe / eZ Cash Sandbox	Test mode only
AI	OpenAI free credits	Limited usage for testing

8. Example Feature Workflows

Teacher Creates Batch: - Dashboard → Batch Management → Add Batch → Assign students → Set schedule

Student Takes Exam: - Mobile App → Select batch → Start Exam → Auto-mark MCQs → Teacher marks short answers → View final result

Analytics: - Teacher Dashboard → Select batch → View lesson performance → Leaderboards → Weak areas

White-Label / Branding: - Dashboard → Upload logo → Select theme color → Batch code prefix customization

9. Recommended Development Roadmap

Phase 1: MVP - Student login / batch join - MCQ exams + auto-mark - Teacher dashboard: create batch, add MCQs, assign exam - Basic analytics (student scores) - Local file upload (PDF/notes)

Phase 2: Full Version - Short answer question support + manual marking - Leaderboards, gamification, streaks - Notifications & announcements - White-labeling (teacher branding) - Payment integration (sandbox first) - Load balancing, Redis caching for scalability

Phase 3: Premium / Optional Add-ons - AI auto-marking - AI MCQ generator from PDF - Video hosting & playback - Live class / WebSocket features - Multi-tenant scaling for 50+ teachers

This document includes: - All teacher features, student features, system features - Examples for each feature - Complete technology stack with free-tier options - Scalability & load handling best practices - Advantages, disadvantages, and development roadmap