

Capstone Project

CS - 5934 Spring 2025

AI-Powered Personalized Learning Platform for Exceptional Learners

Phase 1 Deliverable



Group 1

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1. Project Charter

1.1 Project Name

Title: AI-Powered Personalized Learning Platform for Exceptional Learners

1.2 Problem Statement

STEM education plays a crucial role in shaping students' analytical and problem-solving skills, yet teaching these subjects to exceptional learner students with learning disabilities poses significant challenges for educators. To effectively support neurodiverse students, STEM education demands dynamic and adaptable teaching strategies that cater to diverse learning needs.

However, traditional teaching approaches often lack the flexibility required to accommodate students with varying cognitive and behavioral challenges. Many educators struggle to identify and implement effective modifications that enhance engagement, comprehension, and accessibility while ensuring that core STEM concepts remain intact.

This project aims to address these challenges by developing an AI-driven system that assists educators in refining their teaching methods based on student learning needs. The system will provide structured yet flexible teaching adaptations, enabling educators to deliver STEM content in ways that maximize student participation and understanding. By integrating intelligent recommendations and adaptive learning pathways, the solution will help bridge the gap between standard instructional methods and individualized support, fostering an inclusive and effective learning environment.

1.3 Project Description

The project will develop a web-based AI-driven platform that assists educators in adapting STEM instruction to diverse learning needs. The system will provide teaching recommendations, offering structured guidance for modifying instructional delivery and engagement strategies. It will feature an interactive dashboard where educators can access AI-powered insights, refine lesson plans, and track progress. With a user-friendly interface and adaptive capabilities, the platform will streamline the process of creating inclusive and effective learning experiences for neurodiverse students.

1.4 Project Outcomes / Deliverables / Final Goals

The project will develop a web-based AI-driven platform that assists educators in adapting STEM instruction to diverse learning needs. The system will provide real-time teaching recommendations, offering structured guidance for modifying instructional delivery and engagement strategies. It will feature an interactive dashboard where educators can access AI-powered insights, refine lesson plans, and track progress. With a user-friendly interface and

adaptive capabilities, the platform will streamline the process of creating inclusive and effective learning experiences.

1.5 Project Team Members and Their Roles:

- Aayush Bagrecha

Frontend Developer: Designs and implements user interface

- Amisha Mehta

Backend Developer: Builds and manages server-side components

- Aryan Agrawal

UX/UI Designer: Ensures accessibility and user-friendly design

- Bhashya Sheth

AI-ML Engineer: Develops AI models for content adaptation

- Chandana Ambekar

Project Manager/GenAI Developer: Oversees project scope, timeline, and deliverables

- Kshitij Narvekar

Team Leader / Cloud Services Manager: Conducts testing to ensure quality and functionality

1.6 Timeline for Completion

- **Week 1-2:** Research & Requirements Gathering + System Architecture Design & Technology Stack Selection
- **Week 3-5:** AI Model Development and Testing
- **Week 4-6:** Frontend and Backend Development (Initial Phase)
- **Week 7-8:** Integration of AI and Interactive Learning Features
- **Week 9-10:** User Testing, Refinement & Debugging
- **Week 10-12:** Final Testing, Documentation, Presentation Preparation & Project Submission

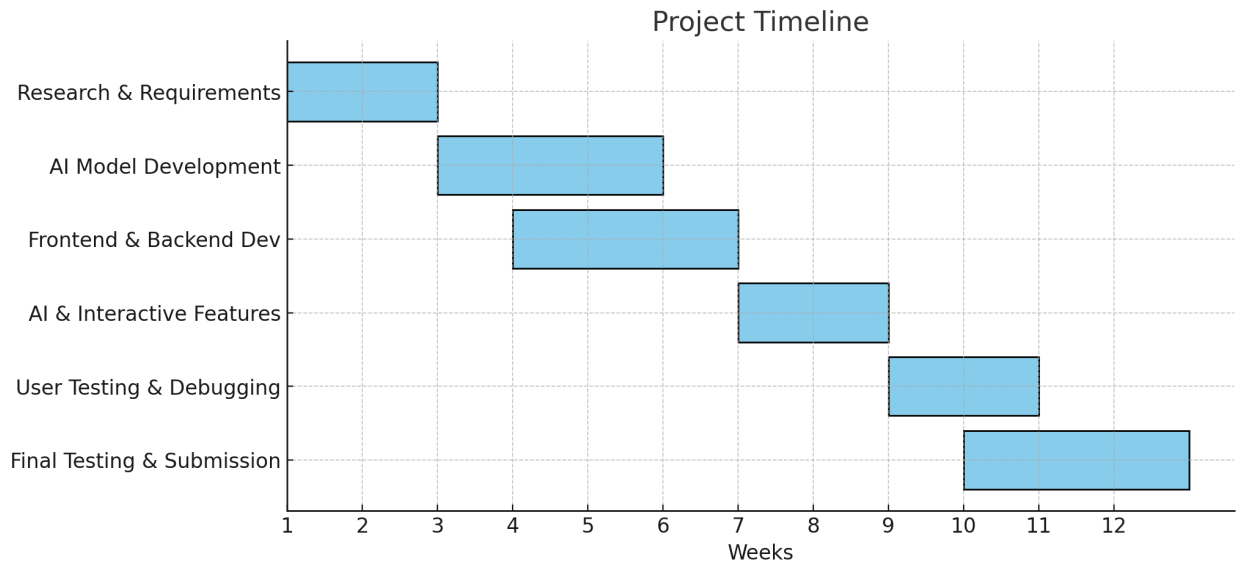


Figure 1: Project Timeline Gantt Chart

1.7 Communication Plan

- Weekly team meetings for progress updates
- Weekly syncs with the project advisor
- WhatsApp for instant communication
- Google Drive for document sharing
- GitHub for version control and collaboration

1.8 Creative Commons License

We are working closely with Dr. Jim Egenrieder and his team, who are experienced STEM educators specializing in neurodiverse learning. They will provide valuable insights into the needs of neurodiverse students, while we develop and deliver a solution that addresses the specific challenges educators face in adapting STEM instruction. This collaboration will ensure that the system we create directly supports their teaching practices and enhances the learning experience for neurodiverse students.

2. The Case for the System (Product)

The increasing number of neurodiverse students in classrooms presents unique challenges for educators, particularly in STEM education, where structured and logical thinking is essential. Existing instructional strategies often fail to provide the level of flexibility and personalization required to cater to students with learning disabilities. The proposed AI-powered platform will bridge this gap by offering dynamic, adaptive, and data-driven teaching modifications, enhancing engagement and learning outcomes.

2.1 Need for the System (Product)

2.1.1 Why is this product needed? What purpose does it serve?

Traditional teaching methods do not sufficiently address the cognitive diversity of exceptional learners. Many students struggle with content comprehension due to rigid teaching structures that lack adaptation to individual learning needs. The AI-powered learning platform will offer personalized teaching recommendations, ensuring students receive content in a manner that aligns with their cognitive strengths and challenges. By integrating AI-driven insights, it will empower educators to refine their instructional strategies, ultimately promoting inclusivity and academic success.

2.1.2 Who are the main stakeholders and end users?

The primary stakeholders and end users of this system include:

- **Educators:** Who will use the platform to adapt STEM lesson plans and teaching strategies for diverse learners.
- **Students with Learning Disabilities:** Who will benefit from personalized learning pathways and enhanced engagement.
- **School Administrators:** Who will ensure implementation and measure effectiveness.
- **Parents and Guardians:** Who will support the learning process and provide feedback on student progress.
- **Education Researchers and Policy Makers:** Who can leverage data from the platform to improve inclusive education policies.

2.1.3 If your system is an app, why does it have to be a mobile app (not a desktop or a web application)?

A web-based platform is the most suitable solution due to the following reasons:

- **Accessibility:** Web applications can be accessed from multiple devices, ensuring students and teachers can interact with the platform from classrooms, homes, and learning centers.
- **Ease of Deployment and Updates:** Unlike mobile apps, web applications do not require manual updates on user devices, making system enhancements seamless.
- **Cross-Platform Compatibility:** A web-based system can be used across different operating systems, ensuring broader reach.
- **Data Centralization:** Storing user progress, AI-generated insights, and lesson plans in a central location enhances usability and analytics.

Given that the primary users are educators and administrators, a web-based approach ensures maximum adoption without requiring frequent app installations or mobile dependencies.

2.2 Current Market

2.2.1 Similar existing systems:

While inclusive education is gaining traction, existing EdTech solutions primarily focus on student learning rather than assisting educators in adapting STEM instruction for neurodiverse students. Platforms like Microsoft Immersive Reader, DreamBox, and Otsimo offer accessibility and adaptive learning tools, but they lack AI-driven guidance for lesson modifications. Most systems require educators to manually adjust teaching strategies without structured support, making it difficult to personalize STEM education effectively.

Our platform addresses these gaps by empowering educators with AI-driven lesson adaptation, automating instructional modifications, and providing structured guidance to make STEM learning more accessible for neurodiverse students.

Few educational technology tools support neurodiverse students, including:

- **Otsimo:** A game-based learning platform designed for children with autism.
- **Microsoft Immersive Reader** – Improves reading accessibility but does not help with STEM-specific instructional adaptations.
- **Teaching LD & Autism Outreach:** Established resources for supporting special education teachers.
- **DreamBox:** An adaptive math learning platform that personalizes instruction based on student progress.
- **Dragon NaturallySpeaking:** A speech recognition software that assists students with dyslexia and other learning disabilities by converting speech to text.

2.2.2 Criticism of existing systems:

- Most existing systems focus on adaptive learning but do not specifically address the challenges faced by neurodiverse students.
- Existing platforms require a lot of manual intervention and are not optimized for individualized STEM learning pathways.

2.3 Competitive Analysis

2.3.1 What is new about our system?

- **AI-Driven Lesson Adaptation:** The system provides personalized instructional modifications based on students' cognitive and behavioral challenges, helping educators tailor STEM lessons effectively.
- **Educator-Focused Design:** Unlike most EdTech solutions that primarily support students, this platform empowers teachers with structured guidance, making lesson planning for neurodiverse learners more efficient.

- **Integrated Teacher Dashboard:** The platform features an interactive dashboard that allows educators to track student progress, assess the effectiveness of modified lessons, and refine teaching strategies accordingly.

2.3.2 How is our system better?

- Focuses specifically on STEM education for exceptional learners.
- Our system focuses on enhancing teacher capabilities through AI-driven professional development and real-time instructional coaching, going beyond mere task automation.
- The system uniquely combines implicit modifications with explicit teaching strategies, providing a more comprehensive approach to personalized learning.

3. System Description

3.1 Technical, Business, or Administrative Problem Addressed:

- The lack of AI-driven personalized learning tools for students with learning disabilities.
- The need for structured and accessible STEM learning strategies.
- The gap in tools for teachers to adapt lessons effectively.

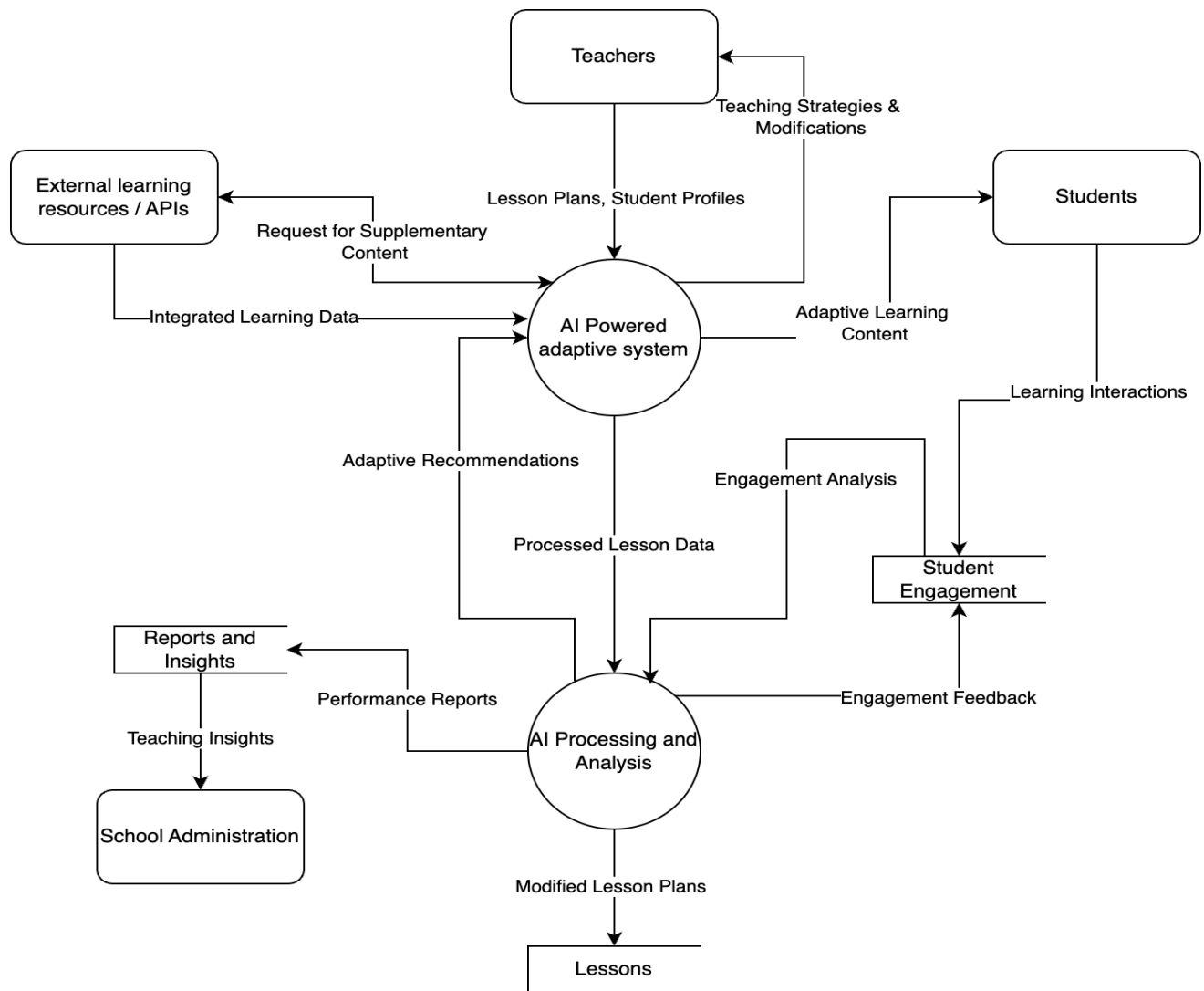
3.2 Dataflow Diagrams (DFD):

1. Context Diagram: Illustrates interactions between users, AI module, and content repository

- **Teacher Inputs Data**
 - The teacher submits lesson plans and student learning profiles to the AI-Powered Adaptive System.
- **AI System Processes Data**
 - The **AI-Powered Adaptive System** processes the inputs and sends the data to **AI Processing & Analysis** for refinement.
- **AI Processing & Analysis Modifies Lessons**
 - Based on the lesson data and student profiles, the AI generates **adaptive lesson modifications** and stores them in the **Lesson Data Store**.
- **Students Interact with Lessons**
 - Students engage with the modified lesson content, and their **learning interactions** are recorded in the **Student Engagement Data Store**.
- **AI Analyzes Engagement Data**
 - The **AI Processing & Analysis** module reviews student engagement patterns to refine **future lesson recommendations**.
- **Performance Reports Generated**
 - The AI system generates teaching insights and stores them in the Reports & Insights Data Store, which the School Administration accesses.
- **External Learning Resources Integration**
 - The AI system can request **additional learning content** from **External Learning Resources/APIs** to supplement the lessons.

- **Adaptive Feedback Loop**

- Based on engagement data and AI analysis, the system continuously refines **lesson modifications** to improve effectiveness.



2. Level-0 DFD: Shows detailed system operations, including content adaptation, student tracking, and user interactions

- **Lesson Submission by Teacher**

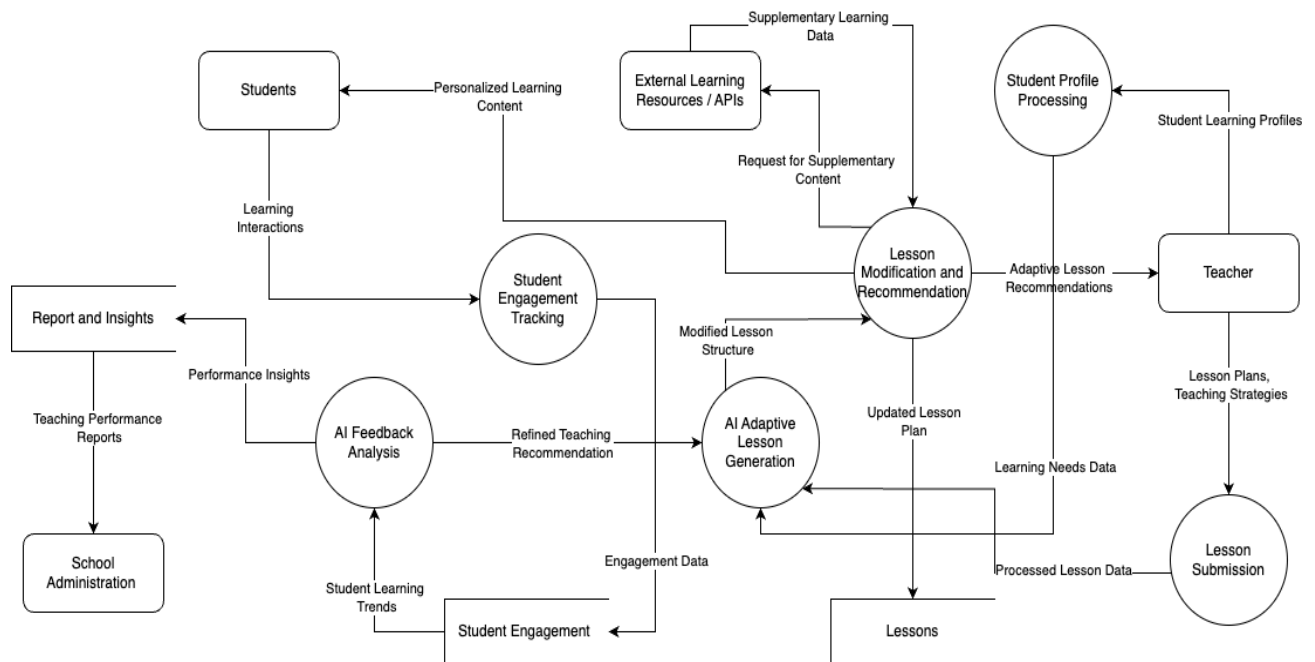
- Teachers upload lesson plans and teaching strategies to the Lesson Submission Process.

- **Student Profile Processing**

- Teachers also provide **student learning profiles**, which are analyzed in the **Student Profile Processing** step.

- **AI Generates Adaptive Lessons**

- The Lesson Submission and Student Profile Processing feed data into AI Adaptive Lesson Generation, where lesson structures are modified based on student needs.
- **Lesson Modification & Recommendations**
 - The modified lessons are sent to the **Lesson Modification & Recommendations Process**, which adjusts the content for different learning needs.
- **Lesson Data is Stored**
 - The Lesson Data Store keeps track of updated lesson plans for future reference.
- **Students Engage with Modified Lessons**
 - The adapted content is delivered to **Students**, who interact with the lessons.
- **Engagement Tracking**
 - The Student Engagement Tracking Process records student interactions and stores the data in the **Student Engagement Data Store**.
- **AI Feedback Analysis**
 - The **AI Feedback Analysis Process** reviews student engagement patterns and learning performance.
- **Reports & Insights Generation**
 - The AI system generates reports based on feedback analysis and stores them in the **Reports & Insights Data Store**, which the **School Administration** accesses.
- **Refinement of Lesson Plans**
 - The AI system continuously refines lesson recommendations based on student performance trends.
- **External Learning Resources Integration**
 - If additional materials are needed, the system requests content from **External Learning Resources/APIs**, enhancing the lesson plans.
- **Adaptive Learning Loop**
 - The AI system iterates and refines the **teaching strategies** based on engagement feedback, ensuring continuous improvement.



3.3 Assumptions and Risks:

- **Assumptions:**
 - AI models can adapt learning materials effectively.
 - Teachers are willing to integrate AI-based tools in classrooms.
- **Risks:**
 - AI cannot replicate the empathy, motivation, and mentorship provided by human educators. This absence of emotional support can hinder students' social and emotional development and engagement.
 - AI systems lack the ability to interpret nuanced student emotions, such as frustration or discouragement, which are critical for effective teaching.
 - AI systems require vast amounts of personal data (e.g., academic records, behavioral patterns), raising concerns about data privacy and security. Inadequate safeguards can lead to breaches and misuse of sensitive information.

4. Team Dynamic

4.1 Skills Team Members Bring:

- AI/ML Development (Model training and adaptation algorithms)
- Full-Stack Development (Frontend and Backend for system implementation)
- UI/UX Design (Creating an accessible and user-friendly interface)
- Education & Pedagogy Expertise (Understanding STEM teaching methodologies)
- Data Analytics (Tracking student performance and engagement trends)

4.2 What skills are missing and you'll need to learn to deliver the system?

- Educational psychology and accessibility best practices.
- Classroom dynamics and teaching methodologies to understand how educators interact with students and structure their lessons.
- Large-scale user testing methodologies to assess system usability and effectiveness across diverse classroom environments.

4.3 How are you planning to obtain such missing skills?

- Self research and expert consultation.
- Working with a dedicated educator from Dr. Jim's team, to understand teaching methods for such neurodiverse kids.
- Online resources and documents on NLP and AI ethics.
- Conducting iterative user testing sessions and gathering feedback from educators and students.