AI-Powered Adaptive Learning System for Primary Students in Qatar

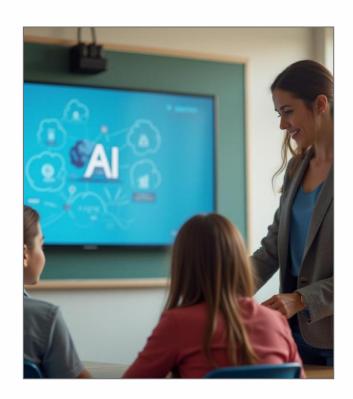*Linking Attendance Data to Personalized Lesson Summaries and Remedial Plans*

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Introduction

This presentation addresses the challenges of learning continuity and remedial planning in Qatar's primary schools. It emphasizes the importance of attendance-linked learning support along with a proposed AI solution aimed at enhancing student outcomes and supporting educators effectively.

The research focuses on identifying barriers to effective remedial learning in primary education in Qatar, influenced by student attendance and performance data. Clearly defining this problem is essential for developing targeted solutions.
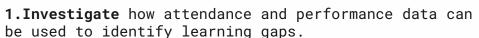
"How can artificial intelligence be applied in Qatari primary schools to support personalised academic interventions by analysing student attendance and performance data?"

This question addresses the integration of AI witah real-time data to support differentiated instruction and improve learning outcomes.

Objectives

1. **Investigate** how attendance and performance data can be used to identify learning gaps.
2. **Design and develop** an AI-driven system that generates lesson summaries and remedial content.
3. **Implement** natural language generation to create age-appropriate materials (e.g., summaries, quizzes).
4. **Evaluate** the system's usability and impact on educational support.
5. **Ensure** the system complies with ethical standards in student data usage.

To develop and evaluate an AI-powered adaptive learning system that automatically analyses attendance and performance data to generate personalised summaries and remedial plans for primary school students in Qatar.

1. AI-Driven Adaptive Learning in Education

AI is revolutionizing how content is tailored to individual learners, especially in K–12 settings.
Source:
Du Plooy et al. (2024) – ITS improves student motivation and personalisation
Komolafe et al. (2025) – Adaptive learning enhances retention for students with different pace and needs

2. Attendance Data & Learning Gaps

•*Attendance data is a strong predictor of performance, but is often underused in real-time intervention.*
Source:
•*Measuring the Credibility of Student Attendance Data* – Questions data accuracy and encourages triangulation
•*Class Attendance & Peer Similarity Study* – Finds strong correlation between attendance and academic success

3. Ethical and Practical Challenges in AI for Education

•*Ethical design is essential in AI systems that handle sensitive student data.*
Source:
•*Transparency Framework for AI in Education* – Emphasizes explainability, student rights
•*Navigating the Ethical Terrain of AI in Education* – Reviews challenges in fairness, bias, and trust

Why DSR?

•**Problem-Solving Orientation:** Ideal for developing an artefact addressing a real-world educational challenge.
•**Structured Iteration:** Supports *design → build → test → refine* lifecycle.
•**Evaluation Built-In:** Encourages early testing of usability and educational value.
Compared to alternatives:
•**Case Study:** not suitable for artefact development
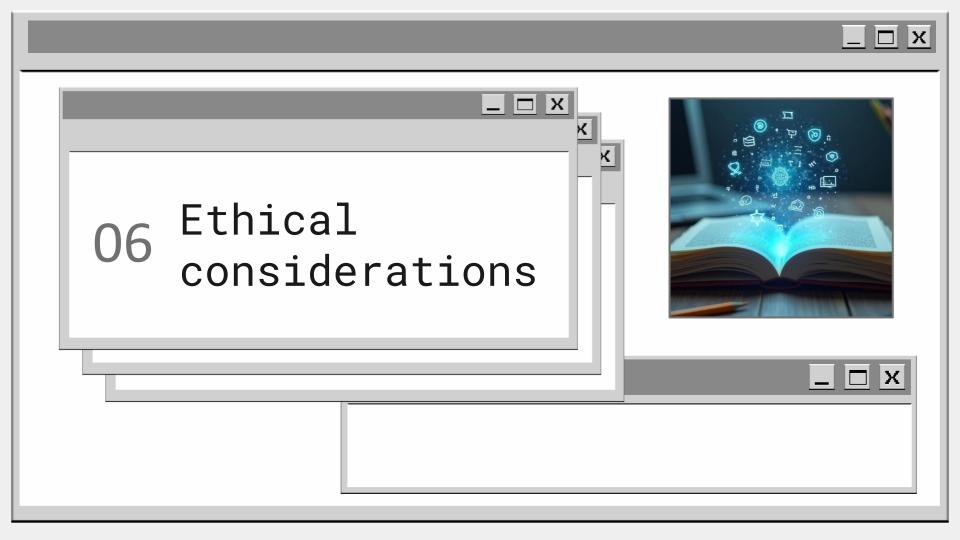•**Experimental Design:** premature without a working system

Methodology

Approach: Design Science Research (DSR)

DSR is selected to design, build, and evaluate a **practical artefact**: an AI-powered adaptive system that provides personalised support based on attendance and performance data.

Research Phases

1. **Problem Identification** (based on attendance/remediation gaps)
2. **Requirements Gathering** (literature + stakeholder feedback)
3. **System Design & Development**
4. **Prototype Evaluation** (usability + impact)
5. **Refinement** based on findings

Ethical considerations

1. Data Privacy and Consent
•Student data will be **anonymized** and stored securely.
•No real student data will be used without **institutional approval**.
•System will follow **GDPR-aligned** practices and Qatar's data protection guidelines.

2. Algorithmic Bias & Fairness
•Risk: AI may unintentionally favour certain student profiles.
•Mitigation:
    •Use diverse sample data
    •Implement fairness constraints
    •Provide **transparent feedback explanations**

3. Educational Appropriateness & Age-Sensitivity
•All content generated will be **age-appropriate and curriculum-aligned**.
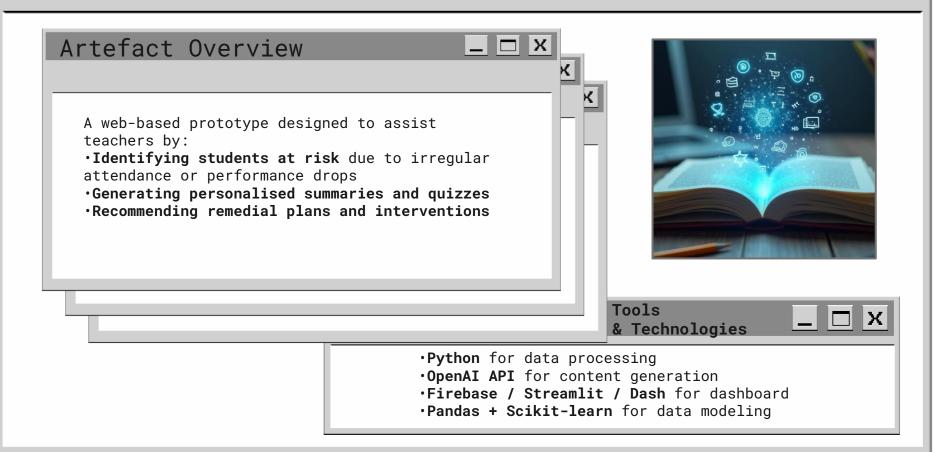•Teacher oversight will be required before content is deployed.

4. Risk of Over-Reliance on AI
•Risk: Teachers may rely too heavily on automated suggestions.
•Strategy:
    •Position AI as a **support tool**, not a decision-maker
    •Include disclaimers and manual override options

5. Ethical Approval Plan
•Full ethical approval will be sought via [University of Essex Ethics Committee] before prototype testing.
•Consent forms and risk mitigation plans will be included.

Artefact Overview

A web-based prototype designed to assist teachers by:
- **Identifying students at risk** due to irregular attendance or performance drops
- **Generating personalised summaries and quizzes**
- **Recommending remedial plans and interventions**

Tools & Technologies

- **Python** for data processing
- **OpenAI API** for content generation
- **Firebase / Streamlit / Dash** for dashboard
- **Pandas + Scikit-learn** for data modeling

Description of artefact

Key Components

1. **Data Input Module**
   - Student attendance and performance (grades/quiz scores)
2. **Learning Gap Detection Engine**
   - Applies AI (e.g., decision trees or regression) to detect at-risk students
3. **Content Generator**
   - Uses **Generative AI (GPT-based)** to create:
     - Short lesson summaries
     - Practice quizzes
     - Simple explanations for missed concepts
4. **Teacher Dashboard**
   - Displays student risk levels, summaries, and recommended actions
   - Allows teacher review, approval, or editing
5. **Remedial Plan Builder**
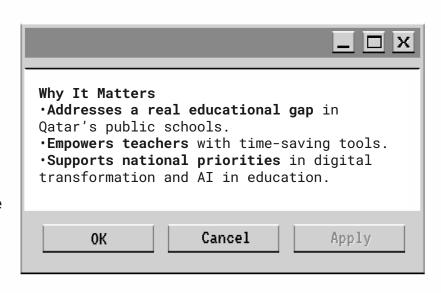   - Suggests targeted follow-ups (worksheets, videos, tasks)

Project Phases

Phase	Weeks	Activities
1. Literature Review & Planning	Weeks 1–2	Finalize sources, structure review, define artefact features
2. System Design & Tools Setup	Weeks 3–4	Select tools (e.g., OpenAI, Firebase), draft architecture, build interface
3. Artefact Development	Weeks 5–7	Code modules: data input, AI engine, content generation, dashboard
4. Usability Testing & Evaluation	Weeks 8–9	Simulated testing with synthetic data, apply SUS or feedback method
5. Refinement & Documentation	Weeks 10–11	Fix issues, improve UX, write documentation and reflections
6. Final Submission Preparation	Week 12	Finalise slides, report, code packaging, and portfolio

Summary
•This project proposes an **AI-powered adaptive learning system** to support students in Qatar's primary schools.
•It links **attendance and performance data** to generate **personalised summaries and remedial content**.
•The methodology is grounded in **Design Science Research**, with a clear development and evaluation plan.
•Ethical and educational considerations are fully embedded in the design.

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Why It Matters
•**Addresses a real educational gap** in Qatar's public schools.
•**Empowers teachers** with time-saving tools.
•**Supports national priorities** in digital transformation and AI in education.

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10 References

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