

Access to Quality Education: Minnow

CS 411W Lab 1 First Draft

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## 1 Introduction

Ensuring access to quality education continues to be a widespread challenge, particularly in under-resourced communities and among students with diverse educational needs. Conventional teaching strategies often fail to address multiple learning styles, physical or cognitive disabilities, and economic barriers, leaving many learners without adequate support. Despite advancements in educational technology, many schools still struggle to adopt tools that enable inclusive, personalized learning at scale.

Challenges in matching instructional materials to student needs are particularly apparent in under-resourced schools, where student proficiency can vary widely. In financially disadvantaged cities such as Baltimore, student proficiency scores often fall below the national average. According to research from the National Assessment of Educational Progress (NAEP), 81 percent of fourth-grade students eligible for free or reduced-price meals demonstrated lower reading proficiency and were four times more likely to drop out of high school. These outcomes persist even though the United States invests more per student in education than most member countries in the Organization for Economic Cooperation and Development (OECD). Such disparities highlight the difficulty teachers face in effectively using standard instructional materials.

A promising strategy to narrow the education gap is the creation of a mobile application that supports both students and educators in overcoming the limitations of traditional resources. Such an application should provide customized learning through adaptive content, integrate accessibility features, and incorporate game-like elements similar to Duolingo. It should foster interaction through dashboards tailored for students, teachers, and parents, and host a content library aligned with school standards. Furthermore, the application should include modular lessons, cloud-based services, and real-time communication to improve engagement and expand access to quality education.

Minnow, a mobile educational application, addresses these objectives by delivering a tailored experience through adaptive content and multimodal features such as speech synthesis and subtitles. With built-in accessibility, interactive learning tools, and multilingual support, Minnow offers a scalable solution designed to make learning inclusive, engaging, and equitable.

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## 2 Minnow Product Description

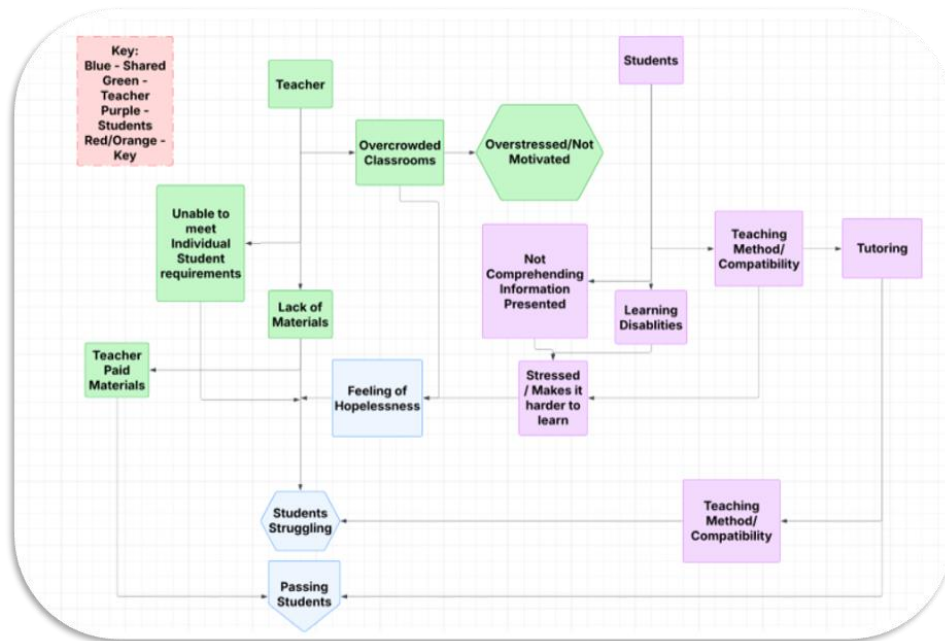


Figure 1: Current Process Flow

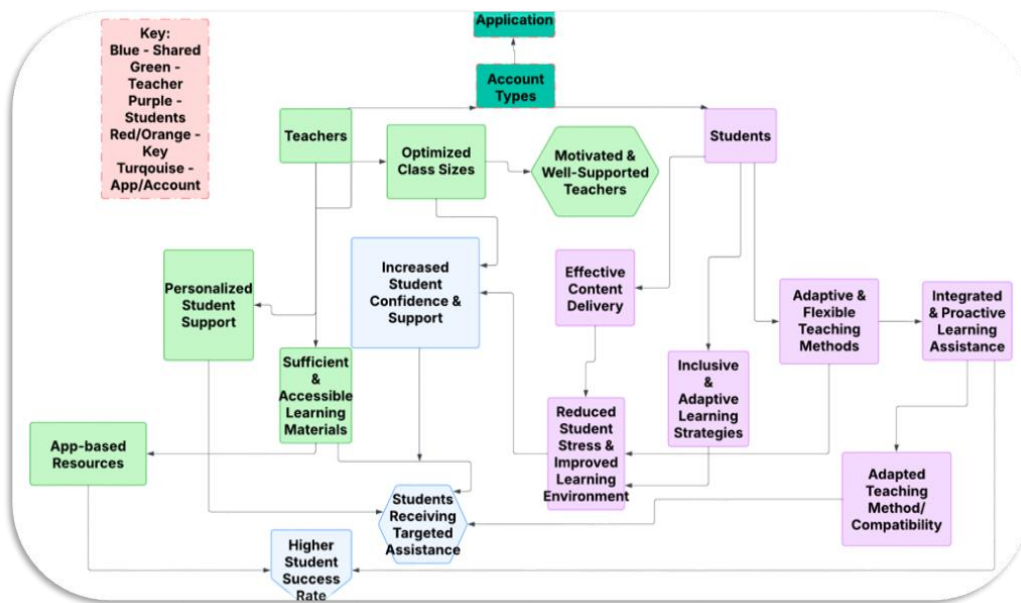


Figure 2: Solution Process Flow

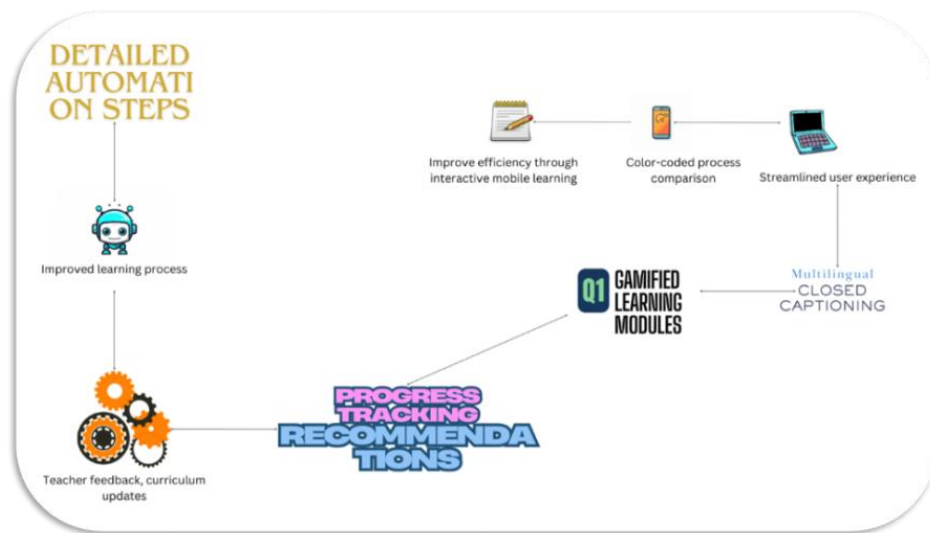


Figure 3: Major Functional Components Diagram

The *Minnow* platform is designed to address limitations in traditional schooling by providing an adaptive, accessible, and digitally driven learning environment. Traditional methods are frequently criticized for being rigid, outdated, and insufficient in preparing students for a globalized and technologically advanced society (High School of America, 2022; World Schools, 2024). By leveraging digital delivery, Minnow aims to bridge these gaps with innovative instructional design.

At its core, Minnow provides interactive learning modules, designed to supplement both classroom instruction and independent study. These modules include multimedia explanations, structured exercises, and formative assessments to help students progress at their own pace. Research highlights that student achievement increasingly depends on high-quality instructional materials, yet access to such resources remains uneven (NASBE, n.d.; RAND, n.d.). Minnow directly responds to this challenge by ensuring consistent access to vetted, standards-aligned materials.

Minnow also integrates language-learning support, a feature modeled after the success of digital platforms such as Duolingo, which have demonstrated scalability and engagement in language education (Duolingo, 2025). As more universities and institutions now recognize alternative proficiency measures like the Duolingo English Test (Manjaly, 2024), Minnow incorporates similar adaptive assessment models to ensure students are not disadvantaged by traditional one-size-fits-all testing systems.

Accessibility remains central to Minnow's design. Many families and communities face barriers to high-quality instruction due to cost, geography, or lack of tailored resources. The platform's structure seeks to address these inequities by reducing reliance on expensive, outdated curricula and instead delivering affordable digital alternatives (ProLiteracy, n.d.; NCES, 2024). Lessons can also be downloaded for offline use, ensuring continuity in regions where network connectivity is inconsistent.

From a broader perspective, Minnow aligns with international efforts to improve equity in education spending and outcomes. Comparative studies reveal disparities in educational expenditures across countries, often tied to student performance and opportunity gaps (NCES, n.d.). By offering scalable, cost-effective solutions, Minnow positions itself as a tool for democratizing access to quality education while also empowering teachers with adaptable instructional content.

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### 3 Identification of Case Study

To assess potential project challenges and their impact on the development of the Minnow prototype, a comprehensive risk matrix was created (see Figure 4). This matrix categorizes possible risks based on their likelihood and severity, providing a visual representation of where project attention and mitigation efforts should be focused.

<i>Risk Matrix</i>		Impact (Scale 1-5)				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
Likelihood of Occurrence	Very Low 1					
	Low 2					
	Medium 3			C1	L1 L2	
	High 4					
	Very High 5		S1	T1 T2		

Figure 4: Risk Matrix

Following the identification of risks, a mitigation matrix was developed (see Figure 5). This figure outlines the proactive strategies designed to minimize or eliminate the impact of each identified risk, ensuring that the project remains on track and aligned with its objectives.

<i>Mitigation Matrix</i>		Impact (Scale 1-5)				
		Very Low 1	Low 2	Medium 3	High 4	Very High 5
Likelihood of Occurrence	Very Low 1					
	Low 2			MC1 ML1		
	Medium 3			C1	L1	
	High 4		MT1 MS1			
	Very High 5		S1	T1		

*Figure 5: Mitigation Matrix*

Risks span several domains, including technical reliability, user adoption, data security, and legal accountability. Technical challenges such as downtime or network outages are likely to occur and could disrupt lessons, lowering teacher satisfaction and confidence in the system (Oudat & Othman, 2024). Data security also represents a major concern; although breaches are less probable, the impact of compromised student or teacher records would be severe. Legal risks compound these challenges, as improper use of copyrighted materials or disputes over academic outcomes could expose the platform to liability (NASBE, n.d.; RAND, n.d.).

The risk matrix visually situates these domains, clarifying which threats are both most probable and most damaging. Technical risks rank high in probability but moderate in impact, while security threats fall on the opposite end—less likely but far more damaging if realized. Legal risks and customer adoption concerns occupy intermediate positions, underscoring the need for ongoing monitoring as well as proactive safeguards.

To address these concerns, mitigation strategies have been developed to reduce both the likelihood and consequences of potential failures. Customer adoption risks are managed through surveys and structured feedback mechanisms to ensure alignment with user needs (ProLiteracy, n.d.; World Schools, 2024). Technical risks are countered by offline lesson availability, which allows teaching to continue during network outages.

Security concerns are minimized through distributed data storage, reducing the damage from any single breach. Legal risks are managed by developing unique content, providing appropriate citation, and using contracts to clarify that the platform does not guarantee academic success.

The mitigation matrix reflects how these actions collectively reduce probability and impact across domains, ensuring the long-term viability of *Minnow*.



## 4 Glossary

**Accessibility Tools** – Features such as text-to-speech, closed captioning, and visual aids that support diverse learners.

**Gamification** – The use of interactive lessons, quizzes, and rewards to enhance student engagement.

**Multimodal Learning** – An approach that integrates various forms of content delivery, including visual, auditory, and interactive methods.

**Personalized Learning** – Adaptive lesson plans that adjust based on a student's strengths and weaknesses.

**Role-Based Access** – A security feature that ensures users (students, teachers, parents) have appropriate permissions based on their role.

**Secure Authentication** – Measures to protect user privacy and maintain data security.

**Virtual Tutoring** – Online support resources designed to assist students outside of traditional classroom settings.

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*From the desk of the CEO: Changing the systems that perpetuate poverty and low literacy.*

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