Lab 1 - Logic Path

Product Specifications

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1   Introduction

Sound reasoning and critical thinking are foundational to academic achievement, civic participation, and professional decision making. The ability to analyze claims, detect flawed arguments, and compare competing sources of information directly influences how individuals vote, make financial decisions, pursue education, and engage in public discourse. In high information and digitally embedded societies, reasoning is not a specialized academic skill but a core ability that supports informed decision making and responsible autonomy. When reasoning skills decline, the consequences extend beyond individual performance to broader social trust, democratic processes, and institutional credibility (Butler 2024).

In our modern society the ability to think critically, judge evidence, and logically reason, has been an increasingly difficult challenge. The rapid growth of digital media, algorithm driven content, and the increasing normalization of misinformation have created an environment in which people are frequently required to assess claims, sources, and arguments without the analytical tools required to do so. Educational researchers have identified this gap as a pressing societal issue, especially since traditional educational models struggle to adapt to the pace and format of modern information consumption. A 2019 study found that 96 percent of students were unable to reliably evaluate the credibility of online sources, which highlights a significant systemic weakness in digital and informational literacy (Breakstone et al. 2019) More recently, the Organization for Economic Cooperation and Development (OECD) reported a decade long stagnation in adult problem-solving and reasoning skills, despite increasing educational attainment and access to information (OECD, 2024). Together, these findings suggest that exposure to information alone is insufficient. And that structured reasoning skills must be deliberately cultivated.

The core problem is not a lack of intelligence or motivation, by rather a lack of accessible and engaging systems that teach logical reasoning as a transferable and practiced skill rather than a purely academic abstraction. Logic instruction is often isolated within philosophy or mathematics courses, framed in highly formal language, and disconnected from everyday decision making. As a result, many learners fail to recognize its relevance, leading to disengagement and shallow retention. An effective solution must satisfy a few key characteristics. It must lower barriers to entry, connect formal reasoning to practical real-world context, adapt to individual learner ability, and sustain engagement over time.

LogicPath is designed to meet these needs by providing a modern, interactive, and accessible platform for developing strong reasoning skills. Rather than treating logic as an abstract academic subject, LogicPath reframes reasoning as a practical tool for everyday use that can be strengthened through guided practice. The platform integrates informal and formal logic instruction through interactive modules, adaptive learning algorithms, and gamified progression systems that encourage consistent engagement. Users receive immediate feedback on their reasoning, allowing them to identify common fallacies, evaluate evidence, and build confidence in constructing sound arguments.

By incorporating real-world scenarios drawn from news, debates, and everyday decision-making, LogicPath bridges the gap between theoretical concepts and practical application. Adaptive difficulty ensures that learners are continually challenged at an appropriate level, while gamified elements such as streaks, achievements, and progression paths help sustain long-term motivation. Through this approach, LogicPath aims to cultivate durable reasoning habits that extend beyond the platform and into academic, professional, and personal environments.

The scope of LogicPath is defined around high school juniors and seniors preparing for standardized tests such as the SAT and ACT, college students in philosophy, law, or STEM programs with formal logic requirements, and anyone seeking to strengthen critical thinking skills. This focus reflects the alignment with the platform's gamified design. Gaming audiences tend to skew younger, LogicPath leverages structured progression systems, quest-based learning, and adaptive difficulty engaging learners during formative academic years while still remaining relevant to adult professionals. The platform is therefore positioned not as a universal education replacement, but as a supplemental reasoning tool tailored to learners who benefit from structured logic development tied to measurable academic and professional goals.

Ultimately, LogicPath addresses the shortcomings of traditional logic education by offering a scalable, technology-driven solution that is both relevant and engaging. In an era defined by information overload and widespread misinformation, LogicPath provides learners with the tools they need to navigate complex information environments with clarity, confidence, and intellectual rigor.

2   Product Description

LogicPath is a web-based educational system composed of two primary components: the learner-facing application and the backend server infrastructure. The learner-facing application delivers interactive logic lessons, gamified challenges, and real-world reasoning exercises through a modern, browser-based interface. The backend infrastructure manages user authentication, adaptive learning algorithms, performance analytics, and long-term data storage. Together, these components form an integrated platform designed to teach logic as a practical, transferable skill rather than an abstract academic subject-based educational system composed of two primary components: the learner-facing application and the backend server infrastructure. The learner-facing application delivers interactive logic lessons, gamified challenges, and real-world reasoning exercises through a modern, browser-based interface. The backend infrastructure manages user authentication, adaptive learning algorithms, performance analytics, and long-term data storage. Together, these components form an integrated platform designed to teach logic as a practical, transferable skill rather than an abstract academic subject.-based educational system composed of two primary components: the learner-facing application and the backend server infrastructure. The learner-facing application delivers interactive logic lessons, gamified challenges, and real-world reasoning exercises through a modern, browser-based interface. The backend infrastructure manages user authentication, adaptive learning algorithms, performance analytics, and long-term data storage. Together, these components form an integrated platform designed to teach logic as a practical, transferable skill rather than an abstract academic subject.

When a learner accesses LogicPath through a web browser, the frontend application retrieves personalized learning data from the server and presents the user with modules tailored to their current skill level. As the learner progresses through lessons, completes challenges, or interacts with real-world reasoning tasks, the application sends performance data to the server. The backend processes this data through adaptive learning engines that adjust difficulty, recommend targeted practice, and update the learner's progression path. Updated feedback and learning recommendations are then returned to the frontend, ensuring that each user receives a dynamic and individualized learning experience.-world reasoning tasks, the application sends performance data to the server. The backend processes this data through adaptive learning engines that adjust difficulty, recommend targeted practice, and update the learner's progression path. Updated feedback and learning recommendations are then returned to the frontend, ensuring that each user receives a dynamic and individualized learning experience.

LogicPath's design emphasizes accessibility and engagement. The system incorporates visual aids, interactive diagrams, and simulations to simplify abstract concepts such as argument structure, logical operators, and fallacy identification. Gamification elements, including streaks, quests, and achievements, encourage consistent participation and help learners build long-term reasoning habits. Real-world application exercises connect logic to news articles, debates, and everyday decisionmaking scenarios, reinforcing the relevance of critical thinking skills beyond the platform.-term reasoning habits. Real-world application exercises connect logic to news articles, debates, and everyday decision-making scenarios, reinforcing the relevance of critical thinking skills beyond the platform.

2.1   Key Product Features and Capabilities

2.2   Interactive Module: Lessons progress from informal reasoning to formal logic, allowing learners to build foundational skills before advancing to symbolic logic, argument mapping, and structured problem solving.-solving.

2.3   Gamified Learning: Quests, streaks, badges, and achievements motivate sustained engagement and transform logic practice into a rewarding, game-like experience.

2.4   Real-World Application: Real-World Application are exercises that appear weekly with contemporary examples drawn from news media, public discourse, and practical decision-making scenarios. This bridges the gap between theoretical logic and applied reasoning using contextual scenarios.

2.5   Adaptive Learning: An adaptive logic engine which dynamically adjusts content difficulty based on the user performance metrics such as accuracy rate. This prevents cognitive overload or stagnation while providing an individualized progression.

2.6   Visual Aids: The platform will integrate diagrams, logical flowcharts, argument maps, and interactive simulations to reduce abstraction when learning formal logic.

2.7   Major Components (Hardware/Software)

2.7.1   Hardware: Logic Path requires minimal hardware from the end user. Any modern device capable of running a modern web browser (laptop, desktop, tablet, or smartphone) can access the platform. On the backend, cloud hosted servers provide computational resources for adaptive learning algorithms, user authentication, and data processing. A cloud-based MySQL instance stores user profiles, learning history, and performance metrics.

Operating System: Windows, macOS, Linux (Any Modern OS)
Web browser: Chrome, Firefox, Edge, Safari (Any Modern Web Browser) -hosted servers provide computational resources for adaptive learning algorithms, user authentication, and data processing. A cloud-based

2.7.2   Software Architecture:

2.7.2.1   Presentation Layer: Built using React, HTML, and CSS.
Provides the user interface for lessons, challenges, visualizations, and feedback.
Handles navigation, module interaction, and real-time update

2.7.2.2   Application Layer: The Application Layer is implemented using Spring Boot, a Java-based framework designed for building scalable, modular, and production-ready backend services. This layer contains the core logic that powers the LogicPath platform, including:

- **Learning Module Engine**
  Delivers structured lessons, evaluates responses, and manages module progression.

- **Gamification Engine**
  Handles streaks, achievements, quests, and reward logic.

- **Adaptive Learning Engine**
  Analyzes user performance and adjusts difficulty levels dynamically.

- **Feedback and Analytics Engine**
  Processes user data to generate personalized recommendations and insights.

Spring Boot enables LogicPath to maintain a clean microservice-ready architecture, support RESTful API communication with the frontend, and integrate seamlessly with

MySQL. Its built-in dependency management, security modules, and scalability make it well-suited for an educational platform expected to grow over time.

2.7.2.3 Data Layer: Powered by MySQL Stores:

- User profiles

- Learning history

- Performance metrics

- Progression data

- Provides strong relational integrity, fast query performance, and broad compatibility with Spring Boot

- Supports future scaling as the user base grows

- **Tech Stack**: **Frontend:** React, HTML, CSS
- **Backend:** Spring Boot (Java)
- **Database:** MySQL
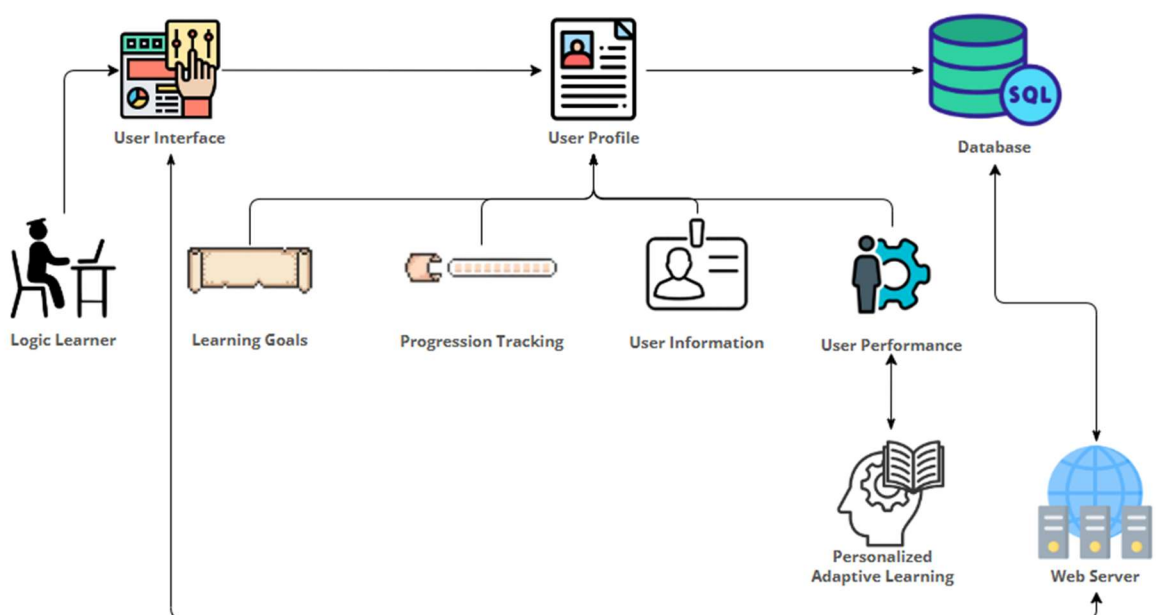- **Hosting:** Cloud-based web server and database services

Figure 1

3   Identification of Case Study

LogicPath is being developed for high school juniors/seniors preparing for standardized tests, college students in logic-heavy disciplines, and adult learners seeking career advancement.

The case study group includes college students at Old Dominion University who will test the prototype and provide feedback. Future users may include educators, institutions, and lifelong learners across various domains.

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4   Glossary

- **Logic:** the systematic use of symbolic and mathematical techniques to determine the forms of valid deductive argument.
- **Formal/Informal Logic:** Formal logic is based off deductively valid reasoning. Informal logic is based off natural languages.
- **IDE**: Integrated Development Environment
- **CI**: Continuous Integration
- **CD**: Continuous Deployment

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