Lab 1 – ReasonED.io Description

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1 Introduction

In today's digital age, the internet functions as a repository of information, fundamentally transforming how information is accessed, consumed, and interacted with. Despite its pivotal role, the internet is riddled with logical fallacies, misinformation, and a lack of emphasis on critical thinking skills (Wardle and Derakhshan, 2017). Logical fallacies, flaws in reasoning, are employed either accidentally or intentionally to strengthen claims. Although not claims themselves, these fallacies significantly impact the quality of discussions online and undermine the credibility of information distribution. Such pitfalls can have detrimental effects on individuals who lack knowledge of logical fallacies and struggle to identify them.

Figure 1 illustrates the absence of evidence fallacy in a post on X about the curvature of the Earth. The creator of this comment suggests that if the visible cities in the background do not show the Earth's curvature, then the Earth must be flat. One piece of evidence, or the lack thereof, does not conclusively prove or disprove a claim, such as whether the Earth is round or flat. A claim like this one can spread misinformation, and people may accept inaccurate beliefs about the shape of the Earth. This, in turn, can foster a distorted understanding of scientific principles, particularly among the 3,900 individuals who shared this post.

Figure 1: Absence of Evidence Fallacy

The challenge arises as students, lacking critical thinking skills, are vulnerable to online fallacies due to inadequate teacher preparation. A report titled “Teaching Critical Thinking in K-12” highlights disparities in the emphasis on critical thinking instruction across the U.S. While 86% of 4th-grade teachers prioritize teaching deductive reasoning, this percentage drops to 39% among 8th-grade teachers, indicating a significant decline in this skill (Bouygues, 2022). According to a 2019 global survey conducted by Cambridge, 50% of teachers reported feeling they lacked sufficient time to teach these skills effectively. Adding to the concern, only 21% of teachers agreed that they possess all the necessary resources to cultivate these skills (Critical Thinking Teaching Survey 2019).

To address this challenge, there is a need for resources designed to enhance logical fallacy identification skills across different grade levels. These resources should not only focus on skill development but also serve as effective tools for educators to teach logical fallacies and improve students’ critical thinking skills. ReasonED.io stands out as a promising solution aligned with these objectives. The game-based learning website addresses the logical identification gap across all age groups, prioritizing critical thinking skill development through interactive 2D games. Beyond benefiting students, ReasonED supports educators with additional resources, including readings, lesson plans, and teaching strategies. This distinction sets ReasonED apart from other platforms like Kahoot! and Quizlet.

2 Product Description

ReasonED.io is a game-based learning website designed to boost users’ logical reasoning skills with engaging games tailored for elementary, middle, high school, and adult learners. These games introduce the concept of logical fallacies in a fun and interactive manner. For educators, ReasonED offers comprehensive readings on logical fallacies, along with resources such as lesson plans, teaching strategies, and general education tools. Committed to accessibility, ReasonED incorporates features including text-to-speech and color contrast to assist individuals with impaired vision. Users are encouraged to provide feedback for ongoing improvements to the platform’s educational offerings.

2.1 Key Product Features and Capabilities

The games are designed for direct play on the website, eliminating the need for additional downloads or logins. This approach creates a seamless and accessible user experience with no barriers to entry. In-game tutorials enhance the user journey by providing interactive guidance,

facilitating an optimal learning experience. The inclusion of text-to-speech and color contrast further enhances accessibility, catering to the needs of a diverse audience. The gaming experience is enriched with engaging elements such as achievements, collectibles, and leaderboards. These elements provide a sense of accomplishment, encourage exploration of critical thinking, and foster healthy competition and community.

The platform enables users to sign up freely and create usernames, which are regulated to create a personalized user experience. Tailored reading materials introducing the concept of logical fallacies cater to each age group, aligning educational content with users' developmental stages. Educators have access to valuable resources including printable graphics, comprehensive lesson plans, and teaching strategies. The printable graphics, functioning as visual aids, can be utilized in classrooms or virtual teaching environments. At the same time, the lesson plans and teaching strategies supply step-by-step guidance on structuring discussion points and assessment strategies.

Featuring distinct difficulty levels organized by age group, the games share the same objective: to introduce and enhance logical identification skills. The concepts and scenarios are simplified for younger players, with the overarching aim being to instill the foundations of critical thinking and foster an ability to recognize flawed reasoning. Each game within the collection personifies a logical fallacy character facing various disagreements in the form of platformers and side-scrollers. Examples include "Straw Manny," teaching the straw man fallacy, "Hasty Harry," illustrating the hasty generalization fallacy, and "Slippery Slope Sadie," introducing the slippery slope fallacy. This innovative approach aims to improve critical thinking skills from an early age, offering a memorable and enjoyable learning experience that goes beyond traditional educational methods.

2.2 Major Components (Hardware/Software)

The hardware required to access the website will be desktops and laptops equipped with a modern browser such as Chrome, Firefox, Microsoft Edge, and others. In terms of software architecture, the website employs a combination of back-end and front-end technologies, as specified in Figure 2. The back-end functionality is supported by a scalable Node.js web server, supporting both scalability and flexibility. Game development utilizes the versatile Godot engine, utilizing C# and GDScript programming languages. Hosting is on Vercel, offering an efficient deployment process. On the front end, the website is built using the Next.js React framework, Tailwind CSS framework, and TypeScript for a responsive design. The development environment

of choice is Visual Code. Version control, issue, tracking, and continuous integration are maintained through Git and GitHub. Task management and milestone tracking are executed using Trello. TypeScript testing libraries, Mocha and Chai, are applied to guarantee code reliability. Effective communication and coordination within the team are facilitated through primary channels, Discord and Zoom.

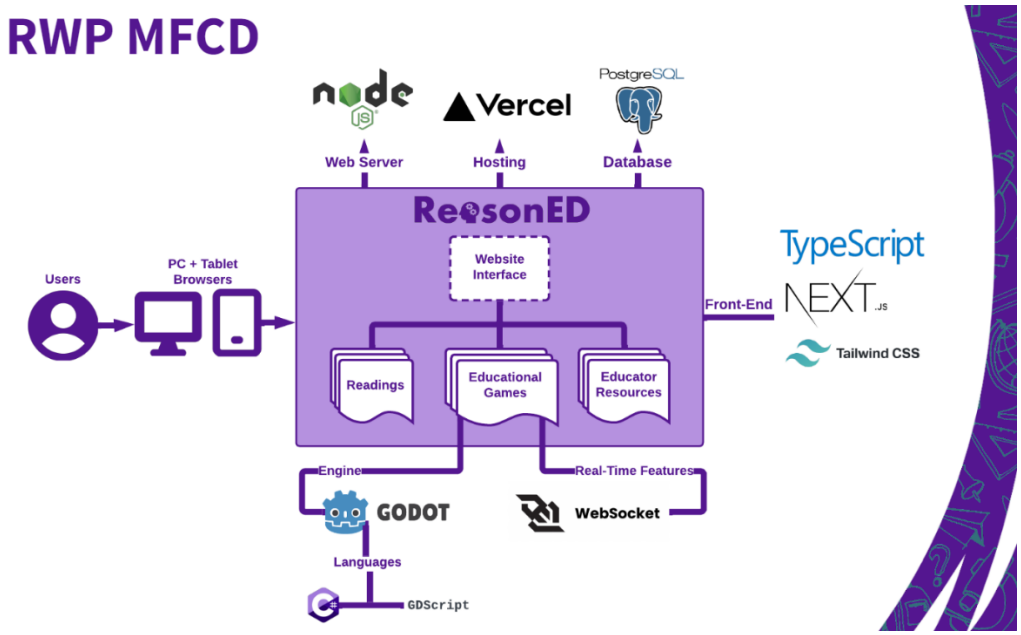

Figure 2: Real World Product Multi-Functional Component Diagram

3 Identification of Case Study

ReasonED is introduced as a comprehensive educational tool aimed at enhancing critical thinking among students and providing valuable support to teachers. This section navigates through different aspects of the case study, starting with identifying its target users and clarifying their roles within the ReasonED platform.

3.1 Intended Users

Educational institutions, including K-12 schools, colleges, and universities are the primary customers of ReasonED. It is designed to be a valuable resource within their curriculum, aiming to foster critical thinking skills among students. The goal is to enhance the overall educational experience and empower students with essential cognitive abilities. In addition to educational institutions, ReasonED extends its reach to educational publishers and content providers. By adopting ReasonED, these entities can enhance their existing offerings and provide an enriched learning experience outside the classroom.

ReasonED's user base consists of various groups, beginning with K-12 students, which also includes homeschoolers. The platform, designed to enhance critical thinking skills, engages this core audience through interactive games and educational content, fostering cognitive development. Transitioning to higher education, ReasonED addresses the challenges faced by college-level students, providing support for advanced critical thinking amidst the complexities of higher education.

Educators, both K-12 teachers and professors, find ReasonED as a valuable tool to integrate into teaching methods. Its interactive and engaging resources enhance logical fallacy education within the classroom setting. ReasonED extends its accessibility to the public, emphasizing the broader value of critical thinking across various facets of life. Individuals from all backgrounds can navigate the platform to identify logical fallacies, contributing to more informed discussions, both online and offline.

3.2 Intended Use

The primary purpose of ReasonED is to deliver engaging and effective education on logical fallacies to various educational stakeholders. Serving as a supplement to traditional classroom learning, it presents an interactive and gamified approach to enhance critical thinking skills while also operating as a standalone resource. This dual function addresses gaps in curriculums where logical fallacies may be overlooked. As a website, ReasonED allows students access during their free time within school once whitelisted on school networks. With the increasing integration of technology in lessons, ReasonED has the potential to gain exposure beyond language arts classes.

3.3 Case Study Group

To augment the utility and accessibility of ReasonED, a collaborative initiative is envisioned with local schools to gain approval for the platform's usage in educational environments. Through close collaboration with school administrators and educators, the goal is to incorporate ReasonED into curriculums as a valuable tool for logical fallacy education.

3.4 Future Use

As ReasonED continues to develop, the goal is to expand the user base beyond traditional educational stakeholders. Lifelong learners, critical reasoning enthusiasts, and those interested in fostering a culture of logic and reasoning are all welcome to join the platform. The objective is to create a widely accessible and adaptable tool for logical fallacy education.

4 Product Prototype Description

The ReasonED prototype will implement a series of algorithms. The prototype games, Straw Manny, Hasty Harry, and Slope Sadie will incorporate algorithms for character customization, educational feedback based on answers, and unlockable achievements. Alongside gameplay algorithms, the prototype will integrate functionalities, such as adaptive learning logic for adjusting difficulty, a user registration and authentication algorithm, and a username regulator for enforcing a blacklist of prohibited phrases and symbols. The team aims to collaborate with local elementary, middle, and high school educators in the Hampton Roads region for product testing, utilizing their access to computers and tablets for testing purposes. Before testing, the website must be whitelisted by local schools to permit educators to use it with students during school hours.

4.1 Prototype Architecture (Hardware/Software)

Supporting the ReasonED prototype requires two essential hardware devices: a PC and a tablet running a modern operating system (Safari, Google, Firefox, etc.). The technological foundation of the prototype comprises a stack with various components, as detailed in Figure 3. The front-end utilizes the Next.js framework and Tailwind CSS, along with TypeScript, to create the user interface. On the back-end, Node.js functions as the web server. The games and real-time features supported by WebSocket are created using the Godot game engine, which utilizes C# and GDScript. Data management is handled through PostgreSQL for robust storage, and the prototype is hosted on Vercel for reliable deployment. It is important to note that this prototype is distinct because it does not contain the reading materials listed as part of the web interface in Figure 2.

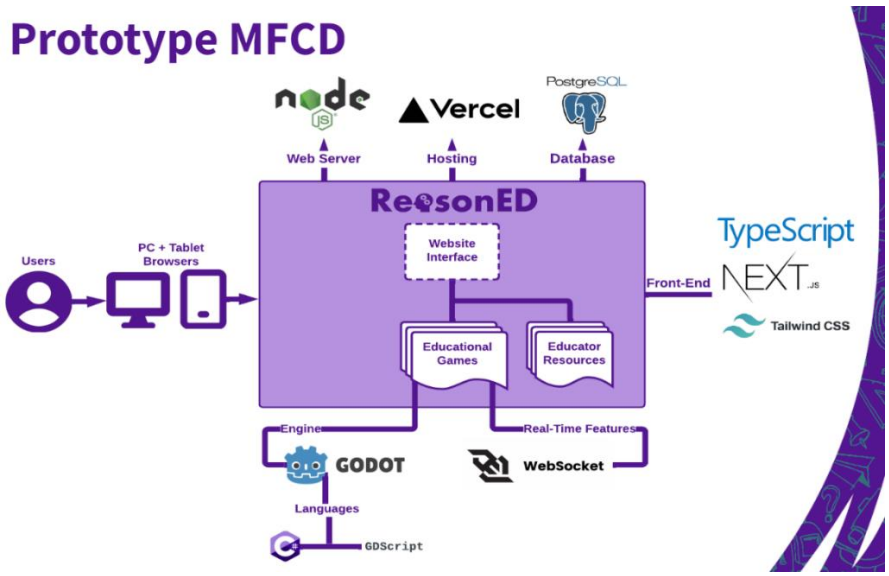

Figure 3: Prototype Multi-Functional Component Diagram

4.2 Prototype Features and Capabilities

Prototype features will differ from those of the real-world product in scale. Some features will be eliminated from the project due to limited development time. A complete list of features is available in Table 1.

RWP vs. Prototype

Features & Functionality	RWP Features	Planned Prototype	Actual Prototype
PC & Tablet compatibility	✓	✓	
Characters+ Animations	✓	✓	
Accessibility Features	✓	Text-to-Speech	
Educator Tools	✓	Printable Graphics, Progress Tracking	
Paid Features	✓		
Games for k-12+	✓	3 games, scaled for 3 general age groups	

Table 1: Real World Product v. Prototype

The ReasonED prototype will serve as an educational platform, offering distinct features for elementary, middle, and high school levels. Within this platform, three engaging two-dimensional games will personify logical fallacies through three unique characters. Straw Manny, embodying the "straw man" fallacy, challenges players to assist Manny in improving combat skills by engaging with real opponents. Hasty Harry, centered around the "hasty generalization" fallacy, tasks players with collecting accurate planet information to prevent flawed generalizations. Slope Sadie, representing the "slippery slope" fallacy, guides players in helping Sadie navigate a snowy path without succumbing to pitfalls.

These games specifically target middle schoolers (grades two and three), and high schoolers. The curation process involves meticulous adjustments for simplicity, regarding levels, feedback, and penalties for incorrect answers. Each game will adhere to a consistent pattern, providing age-appropriate explanations about specific logical fallacies, followed by feedback to aid players in understanding and recognizing similar patterns in real-life scenarios. The prototype includes printable graphics for both in-person and online learning environments, providing visual aids to enhance the teaching experience. Integrated progress-tracking features allow educators to monitor

and assess student performance over time. To foster inclusive learning, the prototype will incorporate text-to-speech functionality.

4.3 Prototype Development Challenges

Developing educational software presents several key challenges. The first challenge is guaranteeing compatibility across different devices, such as chromebooks in elementary schools and tablets in high schools. This entails consideration of varying operating systems and screen sizes to optimize performance.

A subsequent challenge revolves around achieving a delicate balance in character design, illustrated by characters like Straw Manny, Hasty Harry, and Slope Sadie. Beyond visual appeal, these characters must engage users while ensuring consistent functionality across all devices.

The implementation of a customizable text-to-speech feature introduces an additional challenge, combining accessibility with customization. This addresses diverse learning, allowing students to derive personalized benefits from the educational content.

Crafting effective educator tools, including the progress-tracking feature poses its distinct challenge. This requires a profound understanding of the specific needs of elementary, middle, and high school teachers, covering aspects from monitoring student performance to tailoring instruction based on individual progress.

Further complexity lies in designing games with each of the three characters for different age groups. This challenge involves sustaining a learning experience while adjusting difficulty levels, feedback mechanisms, and penalties appropriate for middle and high school students.

Collaboration with local schools for testing introduces its set of challenges, including navigating whitelisting processes and ensuring a smooth testing process. This collaborative effort is crucial for gathering valuable feedback from both educators and students, enhancing the iterative development of the prototype.

5 Glossary

Confirmation Bias - A cognitive bias that involves seeking, interpreting, and remembering information that confirms one's preconceptions (American Psychological Association n.d.).

Critical Thinking - The ability to think clearly and rationally, understanding the logical connection between ideas and the ability to make reasoned judgements (American Psychological Association n.d.).

Fact-Checking - The process of verifying the accuracy of claims made in public discourse and journalism (Cambridge English Dictionary n.d.).

False Dilemma - A fallacy that presents a limited set of options as the only possible choices when there may be other alternatives (Excelsior OWL n.d.).

Logical Fallacy - An error in reasoning or a flawed argument that can make an argument appear valid when it is not (Nikolopoulou, 2023).

Misinformation - False or inaccurate information shared, often unintentionally, without the intent to deceive (Dictionary.com n.d.).

Disinformation - False information deliberately spread to deceive or mislead others (Dictionary.com n.d.).

Slippery Slope - A fallacy that suggests one small step will inevitably lead to a chain of related events, often with exaggerated consequences (Excelsior OWL n.d.).

Straw Man Argument - A fallacy that involves misrepresenting an opponent's argument to make it easier to attack and refute (Excelsior OWL n.d.).

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