JEVelopmenting Project Proposal

Executive Summary

7% of the world population suffers from a learning disorder called dyscalculia. This disorder causes individuals to struggle with understanding mathematical concepts and the process of solving math problems. If left unaddressed, dyscalculia can limit a student's academic progression and future STEM-related career opportunities (Haberstroh & Schulte-Körne, 2019). To help solve this problem, our team proposes an interactive app designed for middle and early high schoolers struggling with one-variable equations in Algebra I. Our app breaks down linear one-variable linear equations into manageable steps, using color-coding and process checklists. Users focus on one step at a time - such as adding like variables - before moving on to the next step, allowing the user to focus on small tasks, making the overall complex problem easier to process. Our app offers an accessible tool to empower young students with dyscalculia and close the learning gap.

Introduction

Problem:

It is estimated that about 3-7% of the population in the world suffers from Dyscalculia (Haberstroh & Schulte-Körne, 2019). Dyscalculia is a type of learning disorder that affects an individual's ability to solve and understand mathematical concepts and problems. Dyscalculia is often

referred to as “math dyslexia” since the disorder influences the parietal lobe of the brain, which is part of the brain that is in charge of mathematical procedures and learning (“Dyscalculia: Montefiore Einstein Neuroscience Center: Montefiore Einstein,” n.d.). Individuals with Dyscalculia often struggle with memorizing and understanding concepts (i.e., a math operation may not feel “intuitive” to them) and sequences of steps to solve a problem (i.e., forgetting what they’re solving/going to solve and restarting) (Watson, 2019). Furthermore, Dyscalculia is an inborn disorder, meaning individuals with dyscalculia are born with the disorder (Clouser, n.d.). Symptoms of the learning disorder usually start to appear in individuals around 6 years old (“Dyscalculia: What it is, causes, symptoms & treatment, “ 2022). Children with dyscalculia are not only at risk of math failure, but they are also at risk of falling behind their peers in early education. This can affect the future prospective careers of these children, as an inability to grasp foundational math concepts can limit access to higher-level coursework, leading them to fail to meet the needs of a degree for a job (especially those in the science, technology, and math fields).

Audience:

The audience of our app is individuals with Dyscalculia in middle school or early high school who are learning Algebra 1 material. The users should be able to easily identify the order in which a solution to a problem starts and ends, given their inability to remember the sequence of steps to solve a particular issue (Watson, 2019). Furthermore, given that people with dyscalculia may have trouble seeing numbers (seeing a 23 as “2” and “3”), arithmetic

symbols, and other components of problems, the users should easily be able to interpret the components of one-variable linear equations through our app (Cleveland Clinic, 2022).

Competition:

Currently, there exist several apps that aim to help people with dyscalculia understand and solve problems; however, most are aimed toward elementary to middle school-aged children. For example, Magrid is an app targeted towards children ages 3-7 and up to 12 years old that teaches the basics of math at an individual pace through simple visual instructions and personalized feedback on performance. However, although scientifically proven to be effective (Magrid, 2024), it is more of a math education platform than a tool designed to guide solving problems in older students. Another competitor, although indirect, is the Dyscalculator by Gary Sharpe, Philip Schlup, and Michael Grawe (DysCalculator, 2025). Their app, as the name suggests, is a calculator specifically designed to aid those with dyscalculia. It features text-to-speech reading, visual representations (i.e., breaking down problems), step-by-step solutions for order of operations, and customization options to make solving standard everyday math (e.g., time, percentages, and basic arithmetic) easier. However, while it serves its purpose as a calculator in a well-executed manner, it does not guide users through solving math problems. These problems are not at the Algebra I level, as they pertain to everyday math leaving those with dyscalculia seeking to solve Algebra I problems still in need of help. In both

of these examples, the apps do consider those with dyscalculia at a very basic level (whether that be targeted towards those of elementary-age or solving everyday math problems that are challenging to people with dyscalculia), however they are not targeted specifically to higher levels of math. As such, our app guides users through one-variable linear problems (e.g. multi-step equations). Furthermore, we will incorporate a similar idea to visualizing a step-by-step solution for the order of operations, as seen in Dyscalculator. However, we will break down math problems into smaller portions, creating a step-by-step demonstration of the necessary steps to solve a particular problem, and prompt users to input the respective answers at each stage. For example, when solving a multi-step equation where like terms need to be combined on both the left and right sides of the equal sign, we will break it down into solving for the combined constant terms (integers) and the combined variable terms (including their coefficients) before solving for the value of the variable.

Specifications

Features:

Our app will provide a step-by-step approach to solving Algebra I problems for students with dyscalculia. The features of the minimum viable product include:

- Manual Equation Entry: Users will manually input one-variable linear equations into the app to start solving

- Color-Coded Problem Components: The app will automatically highlight like terms and key components in different colors, helping users visually organize and distinguish information.
- Interactive Step Checklist with Equation Display: As users go through a checklist of problem-solving steps, the app will also display the equation relevant to each step. For example, when instructed to "add all orange numbers," the app will show the specific addition equation to solve, ensuring clarity, moving on when the user enters in the correct number.

Full checklist (orange numbers are x coefficients and blue numbers are the constants):

- Add all the orange numbers on the right side together. Then subtract the orange numbers on the left side from that sum.
- Add all the blue numbers on the left side together. Then subtract the orange numbers on the right side from that sum.
- Divide the blue number by the orange number. The result is the value of x.

Feedback:

We will be reaching out to local middle and high schools to ask for potential input from students in Algebra I with dyscalculia. We will also reach out to users of our app with optional

surveys for real-time user input. This will help us improve ease of use, clarity of instructions, and the visual supports.

Potential Future Additions:

If additional time allows, we plan to add:

- Voice Assistance: Step-by-step instructions to further reduce issues with visualizing and reading numbers.
- Optical Character Recognition (OCR): Users can upload pictures of printed or handwritten equations that the app will extract.
- Expanded Math Topics: We hope to expand past one-variable linear equations to also support systems of equations, higher power equations, as well as other subjects such as geometry.

References

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