SASTA OLIPHANT SCIENCE AWARDS

Prize Winner

Programming, Apps & Robotics

Year 11-12

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Oliphant Science Awards Submission

Category: Programming, Apps & Robotics

Project Title: GoSmashMaths! - An Educational App Using Neuroscience and Neurodesign to Help Reduce Maths Anxiety in Students

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Acknowledgments

The development of GoSmashMaths! was supported by scientists, teachers and classroom feedback. Dr Fiona Kerr (neuroscientist) provided advice on how neurodesign can support learning. Rebecca Starling (psychologist, and systemic education consultant) shared strategies for inclusive teaching and neurodiverse learning, and Scott Xi (app and UX developer) assisted with design and development. I'm also grateful to the 60 students, 10 teachers, and 70 survey participants who tested the games and app prototype which helped define GoSmashMaths! final design.

Background and Objectives

Maths can be a challenging subject for many students, and it is estimated that over 100 million children worldwide experience maths anxiety. Globally, research shows that maths anxiety can begin as early as the age of six, and often causes a fear of failure, low confidence, and ongoing difficulty with learning maths. In Australia, the country's OECD (Organisation for Economic Co-operation and Development) ranking in mathematics has fallen from 11th to 29th, highlighting a need for innovative solutions that engage students while reducing anxiety and cognitive overload. The 2017 Westpac Numeracy Study found that maths anxiety affects around a third of both adults and children in Australia, showing just how common it is across all ages. Other studies suggest that for many adults, maths anxiety starts during school - which makes early support and intervention even more important.

GoSmashMaths! is a neuroscience, and neurodesign-based learning app created to help students manage maths anxiety through fun, interactive, and adaptive tools. It started as a set of board and card games and was developed into a digital app using feedback from classroom testing and expert input. The GoSmashMaths! app uses game-based learning, visual prompts, and positive reinforcement loops to create a more inclusive experience - especially for neurodiverse students who thrive with structure, clarity, and encouragement.

The GoSmashMaths! app was built from my award-winning physical games, developed for the 2024 Oliphant Science Awards and tested in classrooms. Development was guided by feedback from 60 students and 10 teachers, and supported by survey data (70 responses) with 92% engagement and 67% reporting increased confidence.

App Access and How to Use

A beta version of the GoSmashMaths! app is available for judges to view if I'm lucky enough to be invited for an interview - I'd love the chance to show how it works in person. I've also included a short demo video with my submission and appendix. The animations are still in progress, but the video gives a good idea of how the gameplay works - which was the technical part I focused on getting right first.

We aim to launch GoSmashMaths! on the App Store in 2026. The project meets all criteria for the Oliphant Awards Apps category - including original concept, science-based design, and a functional demonstration version.

How to Play:

Players start by selecting a game from the dashboard (e.g. Minus Madness or Match & Multiply). Each game presents a grid of colourful number cards. Players use drag-and-drop mechanics to solve maths problems - for example, matching two cards that equal the target number. Correct answers trigger animated feedback and rewards - like badges, avatars, and positive thought bubbles - to keep students encouraged and moving forward. Players can switch games anytime from the dashboard, and gameplay adjusts to match how they are going, making it fun, flexible, and supportive.

Animated motivation loops appear after each milestone - high-fiving progress with fun graphics - avatars, rockets - with positive personalised messages.

Why the Game Ends the Way it Does

In GoSmashMaths!, gameplay ends when the deck runs out or no more moves can be made - not by a time limit. This feature means there is no time pressure and lets students play at their own pace. Scoring is visual and positive - with rockets, badges, and stars to reward effort, progress, and sticking with it. These choices were created using neurodesign principles that help build confidence, especially for students who find maths challenging.

Quick Instructions:

1. Tap on a game tile (Minus Madness, Match & Multiply, etc.).
2. Solve maths problems by dragging cards into the correct spots.
3. Earn stars, badges, and encouragement animations as you progress.
4. Return to the dashboard anytime to try a different game.

Visuals and gameplay flows are included in Appendix A (Figures 5–12).

Development Process and Tools Used

GoSmashMaths! has evolved through many iterations - from the initial prototype to a working beta version that's still in development. The process has included:

1. GoSmashMaths! Concept and Planning
   - GoSmashMaths! started with the physical board games I designed, along with my research into student maths anxiety and the application of neurodesign principles. I focused on the areas where traditional maths learning creates obstacles - students feel overwhelmed, and maths starts to feel out of reach, especially for those who struggle with maths.
   - Early versions of GoSmashMaths! were tested as physical games (winning 3 Oliphant Science Awards in 2024) before developing into an app.
2. Design and Prototype
   - Wireframes and UI/UX designs were created using Figma. A clean, visually structured interface was designed using neurodesign principles.
   - Core game mechanics - like drag-and-drop, milestone tracking, visual scaffolding - were mapped-out to support interactive learning.

GoSmashMaths! Card + Board Games

Subtraction Card and Board Game

(Achieved an Oliphant Science 2024 Award)

Figure 1. GoSmashMaths Minus Madness! Card Board Game is a subtraction-focused game featuring calming colours, bold numbers, and clear pathways to guide players through subtraction challenges. Designed with neurodiverse learners in mind, it reduces anxiety and promotes confidence in solving subtraction problems.

GoSmashMaths! Card + Board Games

Addition Card and Board Game

(Achieved an Oliphant Science 2024 Award)

Figure 2. GoMashMaths! All Adds Up! Card Board Game (focuses exclusively on addition, using colourful boards and intuitive gameplay to make learning addition fun and accessible. The game's design fosters engagement and confidence by encouraging incremental progress through neurodesign principles.

GoSmashMaths! Card + Board Games

Addition + Subtraction Card and Board Game

(Achieved an Oliphant Science 2024 Award)

Figure 3. GoSmashMaths! Plus or Minus? Card and Board Game combines addition and subtraction in an engaging, fun card and board game designed to teach foundational maths skills. Its vibrant, colour-coded pathways and neurodesign-inspired visuals reduce cognitive load and enhance usability, particularly for neurodiverse learners.






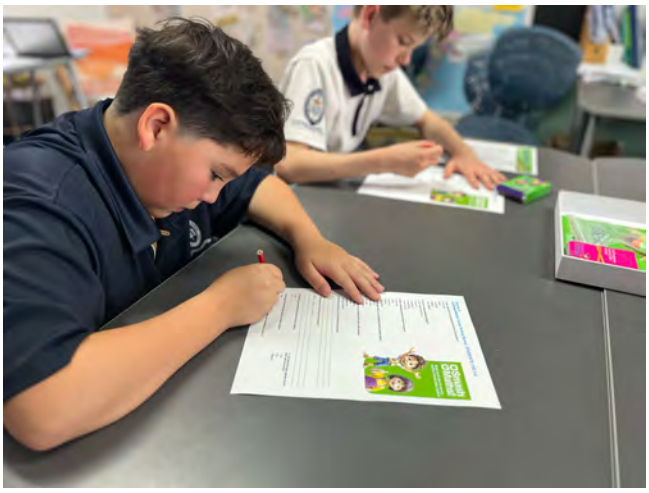


Figure 4. GoMashMaths! All Adds Up!, Minus Madness and Plus or Plus or Minus Card and Board Games - User Testing in Action!

These photos capture students testing the games and completing feedback surveys, which informed my app's operational mechanics and highlighted the effectiveness of neurodesign principles in engaging students during gameplay.

GoSmashMaths! App Prototype Design

Landing Page Design and UX Development

The GoSmashMaths! landing page welcomes users with vibrant colors, the GoSmashMaths! logo, and friendly avatars setting a fun, relaxed scene with a relatable tone. The design focuses on simple navigation, accessibility and inclusivity, encouraging students to be eager to dive into their GoSmashMaths! learning journey with confidence and excitement.

Simplified navigation and avatar selection on the Pre-Game Selection Screen in the GoSmashMaths! app prototype. This design allows the user to play in their own time, reducing cognitive load - allowing users to intuitively choose their game and avatar.

Figure 5.
Logo: Centered at the very top of the screen, the GoSmashMaths! logo is prominently displayed - bright and colorful to grab attention.
Avatars Carousel: a horizontal carousel where users can swipe through and select different friendly character -which hero different math games.

GoSmashMaths! App Prototype Design

Pre-Game Selection Page Design for UX Development

The selection page provides users with an intuitive way to choose the GoSmashMaths! game they would like to play and an avatar. Each game is represented with a vibrant screen featuring its name, description, and associated game avatars. This user-friendly design simplifies navigation and reduces cognitive load, ensuring learners can jump into their preferred game right away.

Simplified navigation and avatar selection on the Pre-Game Selection Screen in the GoSmashMaths! app prototype. This design allows the user to play in their own time, reducing cognitive load - allowing users to intuitively choose their game and avatar.

Figure 6.
Game Name: Displayed prominently at the very top of the screen, the GoSmashMaths! title is bright and colourful, designed to grab attention and set an engaging tone.
Pre-Game Selection Screen: this screen allows users to choose their math game and avatar, setting the stage for a fun and interactive learning experience
Avatars Carousel: a horizontal carousel where users can swipe through and select different friendly character -which hero different math games

GoSmashMaths! App Prototype Design

Selection Page Design for UX Development

Game Selection

The game selection page provides users with an easy-to-navigate interface, featuring high-contrast buttons and clear icons for accessibility. Each button represents a different GoSmashMaths! game (eg. Minus Madness, Plus or Minus, It all adds up!) with a brief description of the game, making it simple for GoSmashMaths! users to select the game they would like to play.

Game selection buttons, each representing a different GoSmashMaths! game, designed with high-contrast colours and friendly icons for accessibility and engagement.

Figure 7.
Game Selection Buttons: Below the avatars, there are five large, rectangular buttons, each representing one of the games (Minus Madness, It All Adds Up, Plus or Minus?, Divide it Up, Match and Multiply). Each button includes:
An icon representing the game (e.g., a subtraction symbol for Minus Madness).
A brief description below the icon explaining the game's focus.

GoSmashMaths! App Prototype Design

Feedback Loops

The GoSmashMaths! app's feedback system includes motivational pop-ups and animations to encourage and guide students to keep going - and that they're smashing maths! Avatar-driven messages like 'Great job!' and 'You're a numbers ninja!' increase maths confidence, while hints such as 'A clue! A tiny addition will open the door!' provides relaxed, 'thought bubble' hints and guidance. Dynamic animations such as paper planes or rockets make the maths experience engaging and reinforce positive learning experience (without realising it!).

Figure 8. In-Game Feedback & Encouragement Wireframe Description

Layout:

- Avatar Pop-Up: When a player makes a correct move, a speech bubble appears next to the avatar with encouraging text (e.g., "Great job! Keep it up!").
- Achievement Animation: Small animations (like confetti or stars) appear on the screen when a player successfully solves a problem or reaches a milestone.
- Error Management: If a player makes a mistake, a subtle prompt appears at the top or centre of the screen with an encouraging message and a hint (e.g., "Try subtracting again!").

GoSmashMaths! App Prototype Development

Landing, Selection & Settings Pages

This section showcases the game's landing page, selection page, and settings page. When the app loads, a random landing page is displayed first. After the player clicks the centre of the screen, they enter the game selection area (defaulted to Plus or Minus). Players can swipe left or right (or tap buttons) to choose a game.

The settings menu can be accessed from any page except the landing page, and its background colour matches the previous scene colour. Within the settings menu, players can toggle the background music and sound effects, check score rankings, and quickly launch their desired game.

Landing, Selection & Settings Pages

You'll meet the bright, smiling, animated GoSmashMaths! avatars when launching the app - on bold landing screens - everytime you visit. Game selection is intuitive - users swipe to explore the other games titles. Settings allow users adjust sound, view scores, and easily navigate back to the game selection page, making it an uncomplicated and fun user experience.

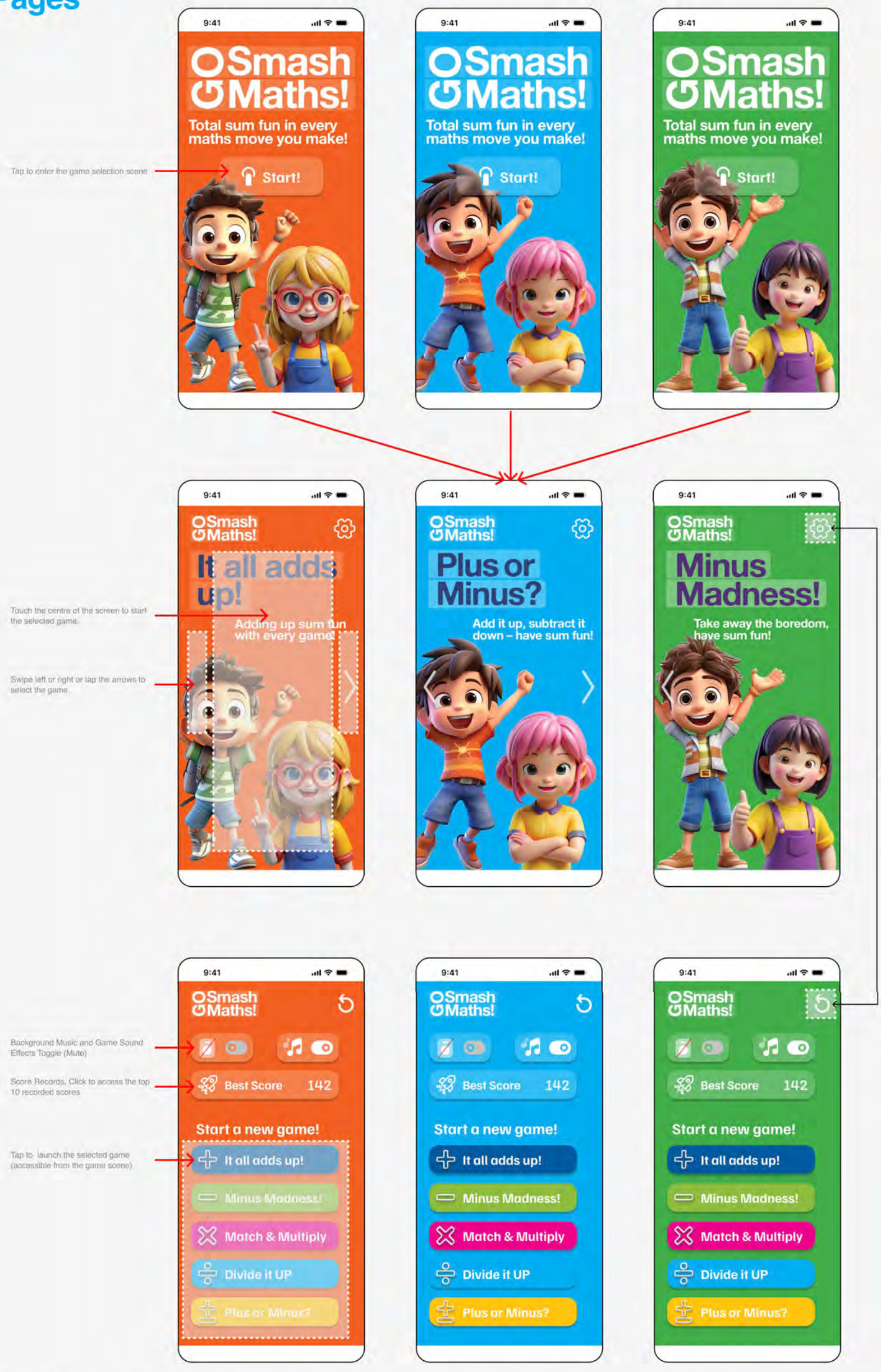

Figure 9. Transitioning to an App Prototype
As part of my project's evolution, my GoSmashMaths! physical card and board games were transitioned into an app prototype, aligning with neurodesign principles to ensure a seamless and engaging user experience for students. The screenshots show the GoSmashMaths! app's visual interface - the development included user feedback from teachers and students though my realtime, in-class gameplay sessions, educators, IT expersts and a neuroscientist.

GoSmashMaths! App Prototype Development

Introduction to the main game interface

Figure 10. Introduction to the Main Game Interfac

GoSmashMaths! app prototype's main game interface introduces players to an interactive and visually engaging maths experience. Features include a clean, simple, but vibrant card display for problem-solving, a progress tracker, and dynamic avatar animations for feedback.

Cards are played by matching operations to targets, reinforcing learning through instant feedback and score updates. The layout is clear and accessible, with intuitive controls and clear visual indicators for actions like matching, selecting, or reshuffling cards.

GoSmashMaths! App Prototype Development

Main Game Interface

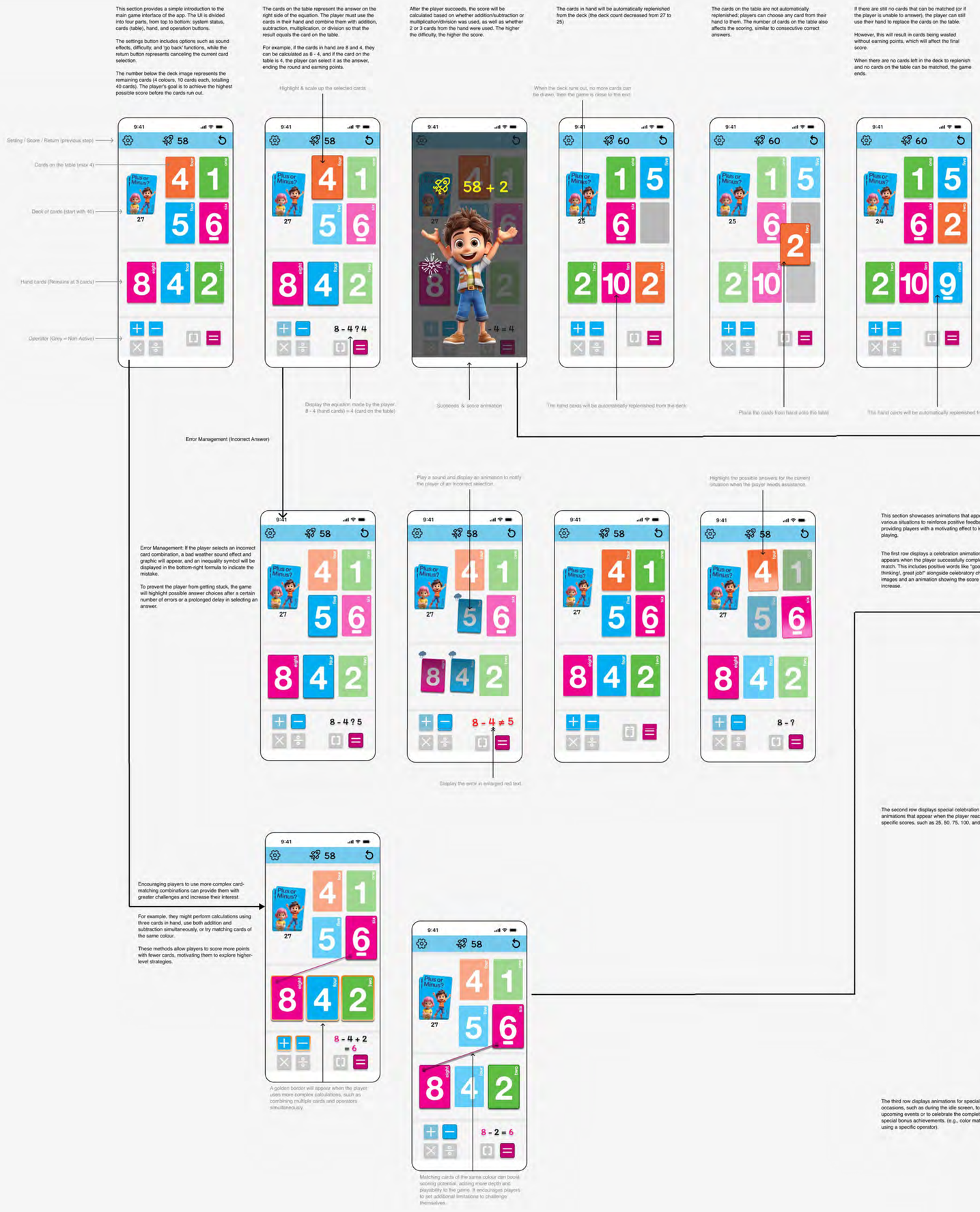

Figure 11. Main Game Interface and Feedback System

GoSmashMaths! main game interface provides a dynamic and interactive space for solving maths challenges. Players engage with clean, uncomplicated, simple cards and bright, positive avatars, guided by clear instructions and responsive animations. The feedback system incorporates 'feel good' messages such as 'Good thinking!' and 'You're a numbers ninja!' to reinforce positive involvement in the game/s. Dynamic content and animations such as rockets or balloons celebrate successes, while subtle hints and 'thought bubble' encouragement messages gently guide students to try again, creating a supportive and rewarding space for all learning levels.

GoSmashMaths! App Prototype Development

Feedback Loops

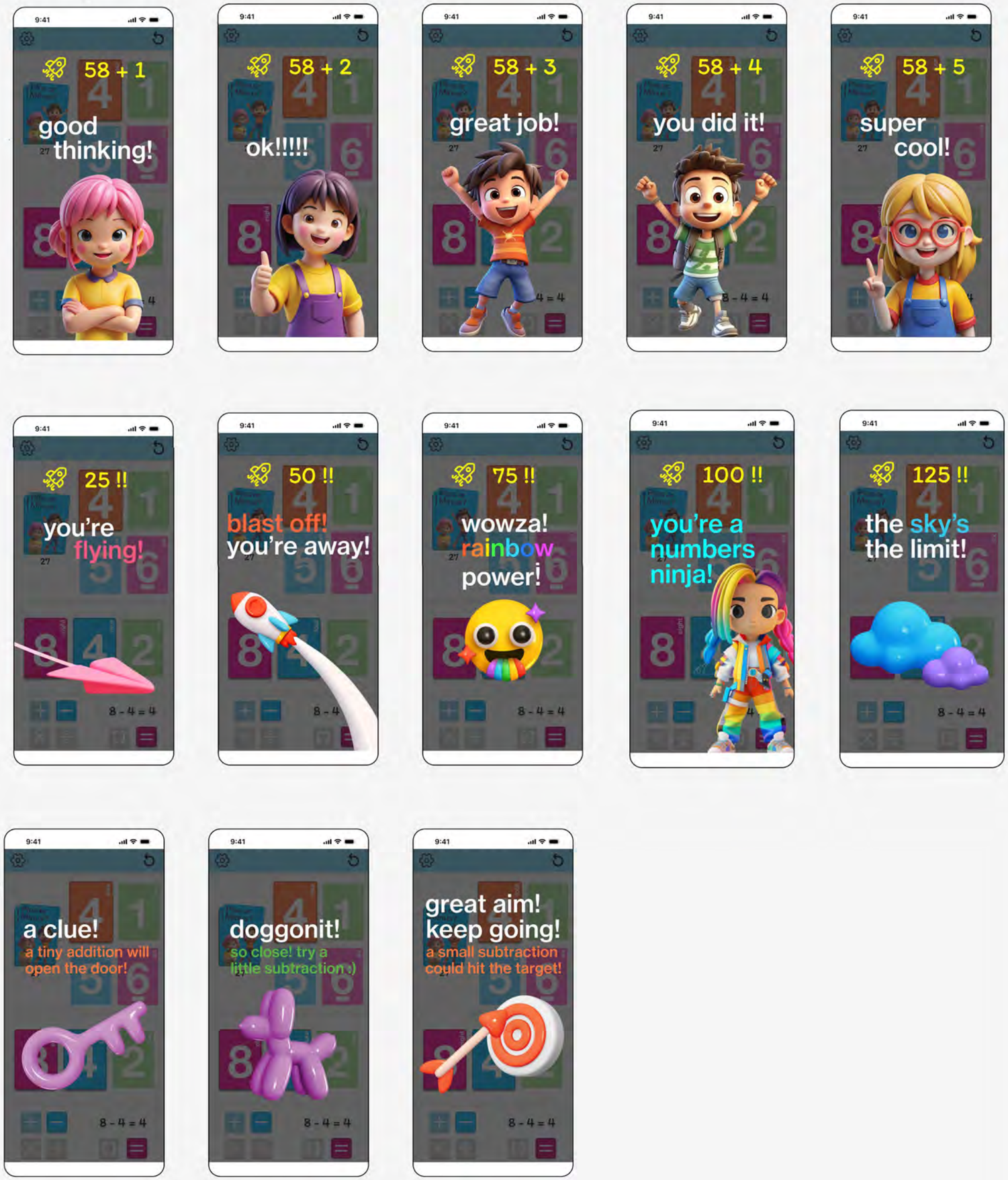

Figure 12. Feedback Loops in Gameplay
GoSmashMaths!'s feedback system uses encouraging natural, conversational messages, animations, and interactive visuals to guide players through their maths challenges. Phrases like'thought bubble' quotes/ messages, like 'You're flying!' and 'Wowsa! Rainbow power!' are big words of encouragement for students and acknowlege their achievements, while hints like 'A tiny addition will open the door!' provide subtle guidance. GoSmashMaths!'s avatars, animations, and bright, modern visuals keep users motivated, connected and engaged. It's a positive, supportive learning space - made for Generation Zs and Generation Alpha and anyone wanting to relax with maths.

Metric	Percentage/Feedback
Engagement (Years 3–4)	92% found the games fun and engaging.
Engagement (Years 5–6)	100% found the games fun and engaging.
Accessibility (Rules easy to follow)	87% (Years 3–4), 75% (Years 5–6).
Maths Anxiety Reduction	67% of students felt more confident in maths.
Interest in App Transition	89% of students supported the transition to a GoSmashMaths! app.

3. Development and Programming
   - The app is being built in React Native with Firebase used on the backend so it works across platforms.
   - Interactive elements include touch-based problem-solving, motivational animations, badges, avatars, and positive thought bubbles - all designed to help students stay engaged and encouraged while they play.
   - Neurodesign principles were used to improve accessibility - including clear, readable fonts, adjustable settings for neurodiverse students, and contrast customisation to reduce visual overwhelm.
4. User Testing and Refinements
   - Initial testing involved 60 students and 10 teachers, providing feedback on usability and engagement.
   - A Google survey of 70 participants showed:
     • 92% of students found the app engaging.
     • 67% reported increased maths confidence.
     • 85% of students felt motivated by the positive reinforcement system (animations, milestone achievements).
   - Iterative refinements included improving navigation clarity, reducing cognitive load, and optimising app responsiveness.

Scientific Justification

GoSmashMaths! is based on research in neuroscience, cognitive science, and neurodesign, with a focus on reducing maths anxiety in students through engaging and supportive design that applies the principles of neurodesign. Research shows that maths anxiety can lead to cognitive overload - making it harder for students to grasp new concepts or solve problems. In line with these findings, the app uses simplified navigation, visual scaffolding, and positive feedback loops to reduce cognitive load and help students build confidence. These features are shaped by principles from cognitive load theory, which supports clearer thinking, better retention, and a more manageable learning experience.

What is Neurodesign?
Neurodesign combines neuroscience and design theory to create experiences that align with how the brain processes information. It draws on principles like cognitive load theory, visual hierarchy, emotional response, and attentional focus - helping reduce overwhelm and increase motivation. GoSmashMaths! applies these principles to create a learning environment that feels calm, clear, and rewarding - especially for students who find maths stressful.

Features & Functionality

GoSmashMaths! is designed to support students through engaging, accessible, and effective learning tools. Key features include:

- Adaptive Learning Paths: The app adjusts difficulty levels based on user performance, offering targeted challenges.
- Interactive Drag-and-Drop Mechanics: Hands-on problem-solving to improve maths retention.
- Gamified Reinforcement: Achievement badges, star ratings, and real-time motivational feedback loops keep students engaged.
- Progress Tracking and Analytics: Provides insights to students, parents, and teachers on learning trends.
- Customisable User Experience: Accessibility features like adjustable contrast, text-to-speech, and personalised avatars.
- Motivational Feedback System: In GoSmashMaths!, correct answers trigger milestone-based feedback at 25, 50, 75, 100, and 125 points - with animated responses like “You’re flying!” or “The sky’s the limit!” tied to avatars, rockets, or stars. If a student gets stuck, subtle guidance appears (e.g. “A tiny addition will open the door”), helping them try again without stress. These visual feedback loops are part of the app’s neurodesign strategy: encouraging progress, reducing anxiety, and making success feel rewarding without relying on pressure or speed.

Error Handling & User Guide

GoSmashMaths! includes built-in support and error handling to help students stay focused, positive and to keep learning, including:

- Navigation Safeguards: Users receive clear guidance prompts if they attempt incorrect inputs, ensuring they can progress without frustration.
- Adaptive Difficulty: The app automatically adjusts problem difficulty based on performance, providing support when needed and increasing challenge appropriately.
- Step-by-Step User Guide: A built-in tutorial introduces students to key features, demonstrating how to navigate the app, use interactive tools, and track progress.

Impact & User Testing Data

GoSmashMaths! began as a set of physical board games that won three awards in the 2024 Oliphant Science Awards, and has since been developed into an app through classroom testing and feedback.

Inclass testing, feedback from 60 students and 10 teachers helped guide app development. A Google survey of 70 participants revealed 92% engagement and 67% increased maths confidence.

User testing played a critical role in developing and refining GoSmashMaths! to meet student needs, especially neurodiverse students. Surveys and in-class testing sessions provided key insights:

• Student Feedback:

"Everything was so fun; I want to play it again!"

"I liked how we had to try and get a higher number to move more spaces."

"Hearing 'You're smashing it!' made me want to keep going even when I got stuck."

• Teacher Observations:

"A student who usually avoids maths played much longer than their assigned time."

"Even my most reluctant learners were engaged and focused."

• Quantitative Results:

- 92% engagement across all tested student groups.
- 67% increase in maths confidence.
- 75% of teachers supported the transition to a full app version.

Appendix A includes supporting visuals and data from testing sessions, including gameplay screens, classroom feedback, and survey results.

Future Directions

Because app development is complex and expensive, my goal is to complete and launch GoSmashMaths! in 2026, after I finish Year 12 later this year (2025).

Planned features for the final release include:

- AI-Driven Personalisation: Adaptive learning algorithms that tailor content based on individual student progress.
- Expansion into Other Subjects: Using the same neurodesign approach to build both physical games and companion apps across literacy and STEM.

Planned titles include:

- GoSmashWords! - phonics and vocabulary through visual learning (English)
- GoSmashScience! - interactive discovery of forces and ecosystems (Science)
- GoSmashWellbeing! - tools for emotional regulation and resilience (Health & Wellbeing)
- GoSmashCoding! - sequencing and logic through playful challenges (Digital Technologies)

... with more in development across Humanities and the Arts.

- Each new title will use a subject-specific gameplay model, adapted to the content area and learner needs.
- While GoSmashMaths! uses number-based interaction, future titles will explore other subject areas - all built on the same neurodesign principles to support confidence, clarity, and low-pressure learning, especially for students who learn differently.
- Every GoSmash! game will continue to focus on accessible design, playful learning, and encouragement over pressure - helping all learners feel capable, curious, and confident.
- Each expansion stays true to GoSmash's core approach: playful design, visual structure, and support for students who learn differently.
- Broader Pilot Testing: Expanding usability testing across rural and urban schools to ensure inclusivity across different learning environments.
- Enhanced Accessibility Features: Integrating voice-guided instructions, haptic feedback, and customisation options for neurodiverse learners.

Supporting Materials and Appendix

All visuals, testing data, user feedback, and bibliography are included in:

oliphant gosmashmaths! app_appendix_willem koehne.pdf

- Appendix A: Visual Figures (Pages 1-13)
- Appendix B: Survey Graphs and Quotes (Pages 14 30)
- Appendix C: Student and Teacher Feedback (Pages 31 64)
- Appendix D: Expert Interviews (Pages 65 102)
- Appendix E: Bibliography (Page 107)

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