

# Final Year Project Dissertation

Title: *MathWhiz: A Mobile Learning App for Primary School Children to Improve Math Skills*

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## Abstract

Mathematics serves as a cornerstone in a child's early education, influencing cognitive development and shaping analytical skills. However, despite its importance, a significant number of primary school children struggle to engage with traditional math instruction. In the digital age, educational technology offers new pathways for engagement, comprehension, and retention. This project presents the design, development, and evaluation of *MathWhiz*, a mobile educational application designed to support primary school students (ages 6 to 11) in learning key math concepts. Leveraging gamification, interactive lessons, and curriculum-aligned content, MathWhiz aims to provide an engaging and personalized learning experience. This dissertation covers the complete lifecycle of the project, from requirement gathering and literature review to design, development, testing, and evaluation. The outcomes of this study show the positive impact educational applications can have on improving motivation and performance in young learners. Ethical considerations and accessibility features were also prioritized to ensure inclusivity. The study concludes with reflections on the effectiveness of the app, suggestions for future improvements, and its broader implications in the educational technology landscape.

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## 1. Introduction

Mathematics is a core subject in the curriculum of primary education across the globe. Its importance in the development of logical reasoning, problem-solving skills, and numeracy cannot be overstated. However, it has been consistently observed that many primary school children find mathematics difficult, boring, or inaccessible. This lack of engagement can lead to learning gaps that carry into secondary education and beyond.

With the increasing availability of smartphones and tablets among families and in educational institutions, mobile learning presents a significant opportunity to revolutionize how children interact with math content. Educational apps, when thoughtfully designed, can address diverse learning needs, provide immediate feedback, and maintain learner motivation through interactivity and rewards.

This dissertation introduces *MathWhiz*, a mobile application designed specifically for primary school learners. The app incorporates core mathematical topics aligned with the UK National Curriculum, gamified interactions, and user-friendly interfaces suitable for children. The study documents the design choices, development methodologies, educational strategies, and testing protocols applied to ensure the app's effectiveness in improving math learning outcomes.

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## 2. Aims and Objectives

### 2.1 Aim

To develop a mobile application that enhances primary school children's understanding and engagement with mathematics through interactive and gamified learning experiences.

### 2.2 Objectives

- Design an age-appropriate, intuitive user interface for children aged 6–11.
  - Develop curriculum-aligned content for key mathematical topics: addition, subtraction, multiplication, division, fractions, and basic geometry.
  - Incorporate gamification elements to motivate and reward users.
  - Provide adaptive difficulty based on user performance.
  - Collect and analyze data from usability and learning outcome tests.
  - Evaluate user satisfaction, engagement, and educational effectiveness.
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## 3. Background and Rationale

Math anxiety and disinterest begin early, often fueled by rote learning and inadequate support for diverse learning needs. Many students fall behind due to lack of personalized feedback, one-size-fits-all teaching, and a lack of engaging content.

Studies have shown that digital tools can significantly improve educational outcomes by introducing interactive, learner-centered environments (Papadakis et al., 2018). Particularly in mathematics, apps that combine entertainment with structured learning content help reduce anxiety and increase motivation.

Given the proliferation of mobile devices in educational settings and homes, a well-designed mobile app can extend learning beyond the classroom, allowing students to practice math concepts at their own pace. This project addresses this need by developing an interactive math app tailored to young learners.

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## **4. Literature Review**

### **4.1 Educational Technology in Primary Education**

Educational technology has transformed teaching and learning processes in recent decades. Research shows that interactive learning environments can enhance comprehension, particularly among younger learners (Becta, 2008). In primary education, where foundational skills are developed, apps can cater to different learning styles and provide multisensory engagement.

### **4.2 Mobile Learning and Gamification**

Mobile learning (m-learning) is defined as learning through portable digital devices such as tablets and smartphones. According to Crompton (2013), m-learning is effective in supporting informal learning opportunities, especially for children.

Gamification is another pedagogical strategy increasingly used in educational apps. By incorporating elements such as points, levels, challenges, and rewards, gamification increases student motivation and engagement (Deterding et al., 2011). In math apps, gamified learning has shown to improve retention and problem-solving skills (Wouters et al., 2013).

### **4.3 Math Learning Apps: Successes and Gaps**

Several studies have examined the effectiveness of math apps. For example, the app *Motion Math* demonstrated a significant improvement in students' fractions understanding after only 20 minutes of use per day (Riconscente, 2013). However, many apps fail to align with curriculum standards or lack adaptive features to support differentiated learning.

A recurring challenge identified in existing literature is the lack of empirical testing of educational apps with real students. Many apps are released without evaluation or consideration of pedagogical principles (Hirsh-Pasek et al., 2015).

### **4.4 Accessibility and Inclusivity**

Inclusivity in educational design ensures that tools are accessible to children with diverse needs, including those with learning difficulties or disabilities. Features such as text-to-speech, large buttons, and minimal clutter are recommended by accessibility guidelines (WCAG, 2020). MathWhiz incorporates such features to ensure it caters to a broad user base.

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## 5. System Design

### 5.1 Requirements Gathering

Requirements were collected through informal interviews with primary school teachers, parents, and a review of the UK National Curriculum for mathematics (KS1 and KS2). User stories and personas were created to reflect the needs of different user types (e.g., early learners, struggling students, teachers).

### 5.2 Architecture Overview

The application consists of three major components:

- **Frontend:** Developed using Flutter, with animations and an intuitive UI for children.
- **Backend:** Firebase for real-time data storage, user authentication, and analytics.
- **Content Engine:** A modular system that dynamically serves math problems and adjusts difficulty.

### 5.3 Core Features

- Gamified quiz levels with increasing complexity
- Reward system (stars, badges, trophies)
- Visual aids (counting blocks, number lines)
- User profiles and progress tracking
- Parent/Teacher dashboard

### 5.4 Design Considerations

- Colorful interface with consistent navigation
  - Large tap targets and voice assistance
  - Offline support for limited connectivity environments
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## 6. Implementation

### 6.1 Development Environment

- **IDE:** Android Studio with Flutter SDK

- **Languages:** Dart (Flutter), JSON for content
- **Version Control:** GitHub
- **Database:** Firebase Realtime Database
- **Authentication:** Firebase Auth (email/password or anonymous)

## **6.2 App Modules**

### **6.2.1 User Authentication**

Basic authentication was implemented to allow multiple user profiles. Children can log in with a parent-created profile or use anonymous login.

### **6.2.2 Math Quiz Engine**

Each quiz is dynamically generated based on selected difficulty. Multiple-choice questions and interactive exercises are supported.

### **6.2.3 Gamification Engine**

Rewards such as badges are granted after completing milestones. A virtual character provides encouragement and feedback.

### **6.2.4 Analytics and Progress Tracking**

Usage data is stored in Firebase to track how often a user engages with different topics, time spent, and improvement trends.

### **6.2.5 Admin Panel**

A basic admin interface (web-based) was created to add new questions, topics, and monitor app performance during testing.

## **6.3 Challenges Faced**

- Designing a UI suitable for young children required iterative feedback and testing.
- Ensuring smooth animations on lower-end devices involved optimizing asset sizes.
- Balancing game-like appeal with educational value required consultation with teachers.