

Algebra Adventure Game - Complete

Overview & Technical Documentation

version 1.2.0

license MIT

platform Web | Android

Table of Contents

- [Overview](#)
 - [Educational Framework](#)
 - [Game Structure](#)
 - [Technical Stack](#)
 - [Architecture](#)
 - [Mission & NPC Mapping](#)
 - [Question System](#)
 - [Installation & Setup](#)
 - [Development](#)
 - [Deployment](#)
 - [Features](#)
-

Overview

Algebra Adventure is an interactive educational game that teaches algebra through real-world problem-solving within the context of Philippine government structure. Players progress through 50 missions across 5 government levels, learning mathematics while gaining civic education.

Key Highlights

- **50 Comprehensive Missions** spanning basic arithmetic to expert-level algebra
 - **Philippine Government Integration** - Learn about Barangay to National government structure
 - **Real-world Applications** - Every math problem relates to authentic Filipino scenarios
 - **Progressive Difficulty** - Carefully designed curriculum from Grade 7 to advanced topics
 - **Gamified Learning** - Engaging gameplay with NPCs, quests, collectibles, and rewards
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Educational Framework

Learning Objectives

1. Mathematics Mastery

- Progress from basic arithmetic to advanced algebra
- 50 comprehensive missions with real-world applications
- Topics include: equations, functions, polynomials, matrices, complex numbers, and more

2. Civic Education

- Learn Philippine government structure (Barangay → City → Province → Region → National)
- Understand roles of different government agencies
- Appreciate public service careers and STEM opportunities

3. Cultural Relevance

- Authentic Filipino context and scenarios
- Philippine government positions and agencies
- Local currency (₱) and culturally relevant examples

4. Career Awareness

- Exposure to various professions (vendors, engineers, scientists, government officials)
- Government career paths (DepEd, DOST, NEDA, etc.)
- STEM career opportunities



Game Structure

Government Hierarchy (5 Levels)

LEVEL 1: BARANGAY (Missions 1-10)

- |— Community Level - Basic Algebra
- |— NPCs: Local vendors, teachers, community officials
- |— Topics: Arithmetic, percentages, simple equations

LEVEL 2: CITY (Missions 11-20)

- |— Municipal Level - Intermediate Algebra
- |— NPCs: Business professionals, urban planners

└ Topics: Linear equations, business math, optimization

LEVEL 3: PROVINCE (Missions 21-30)

└ Provincial Government - Advanced Algebra

└ NPCs: Provincial officials and department heads

└ Topics: Quadratics, systems, advanced functions

LEVEL 4: REGION (Missions 31-40)

└ Regional Government - Mastery Level

└ NPCs: Regional directors of national agencies

└ Topics: Polynomials, matrices, complex functions

LEVEL 5: NATIONAL (Missions 41-50)

└ National Government - Expert Level

└ NPCs: Cabinet secretaries, national scientists

└ Topics: Complex numbers, proofs, advanced theorems

Philippine Government Agencies Featured

- **DepEd** - Department of Education
- **DOST** - Department of Science and Technology
- **CHED** - Commission on Higher Education
- **NEDA** - National Economic and Development Authority
- **PAGASA** - Philippine Atmospheric, Geophysical and Astronomical Services Administration
- **PSA** - Philippine Statistics Authority
- **DBM** - Department of Budget and Management
- **DTI** - Department of Trade and Industry
- **DA** - Department of Agriculture
- **DOH** - Department of Health
- **DPWH** - Department of Public Works and Highways
- **DSWD** - Department of Social Welfare and Development
- **DILG** - Department of Interior and Local Government



Technical Stack

Core Technologies

Technology	Version	Purpose
Next.js	15.3.1	React framework for web application

Technology	Version	Purpose
React	19.0.0	UI library for component-based architecture
TypeScript	5.x	Type-safe JavaScript development
Phaser	3.90.0	Game engine for 2D gameplay
TailwindCSS	3.3.0	Utility-first CSS framework
Supabase	2.75.0	Backend as a Service (authentication, database)
Capacitor	6.2.1	Cross-platform mobile deployment

Development Tools

- **Lucide React** - Icon library
- **PostCSS** - CSS processing
- **Autoprefixer** - CSS vendor prefixing
- **ESLint** - Code linting

Platform Support

- **✓ Web** - Modern browsers (Chrome, Firefox, Safari, Edge)
- **✓ Android** - APK build via Capacitor
- **✓ PWA** - Progressive Web App support

Architecture

Project Structure

```
FIONA/
├── src/
│   ├── app/                      # Next.js app directory
│   ├── game/                     # Phaser game logic
│   │   ├── scenes/               # Game scenes (Boot, Preloader, Game, etc.)
│   │   │   ├── PhaserGame.tsx    # Phaser-React integration
│   │   │   └── EventBus.ts       # Event communication system
│   │   └── components/          # React UI components
│   │       ├── EnhancedQuizSystem.tsx
│   │       ├── Leaderboard.tsx
│   │       ├── Shop.tsx
│   │       └── ...

```

```
|   └── lib/                      # Utility libraries
|       └── supabase.ts          # Supabase client
|   └── types/                   # TypeScript type definitions
└── public/
    ├── assets/
    |   ├── audio/                # Sound effects and music
    |   ├── images/               # Sprites, backgrounds, UI
    |   └── maps/                 # Tilemap JSON files
    └── icons/                  # PWA icons
└── documentation/           # Game documentation
└── android/                 # Capacitor Android project
└── dist/                     # Build output
```

Key Systems

1. Game Engine (Phaser 3)

- Scene management (Boot → Preloader → MainMenu → Game)
- Sprite rendering and animation
- Physics and collision detection
- Tilemap integration for multi-level maps

2. Quiz System

- 50 unique questions stored in `src/App.tsx`
- Multiple choice format with 4 options
- Detailed explanations and step-by-step solutions
- Formula references and hints
- Dynamic difficulty progression

3. NPC Interaction System

- 50 unique NPCs mapped to missions
- Dialog system with quest progression
- Mission completion tracking
- Reward distribution

4. Leaderboard System

- Real-time score tracking via Supabase
- Global rankings
- Player statistics and achievements

- Secure data validation

5. Shop & Reward System

- In-game currency (coins)
- Purchasable items and power-ups
- Collectibles and achievements
- Progress-based unlocks

6. Collision System

- Custom collision editor
- Multi-map collision data
- Debug mode for testing
- Optimized collision detection

7. Timer System

- Mission time tracking
- Performance metrics
- Speed-run challenges
- Time-based rewards

Mission & NPC Mapping

Level 1: BARANGAY (Missions 1-10)

Mission	NPC	Topic	Location
1	Vendor Mang Pedro	Market calculations	Barangay Market
2	Store Owner Aling Maria	Discounts & percentages	Barangay Store
3	Coach Miguel	Perimeter & geometry	Sports Court
4	Baker Tess	Unit conversions	Barangay Bakery
5	Student Leader Ana	Basic budgeting	Barangay School
6	Gardener Noel	Area calculations	Barangay Garden
7	Math Teacher Mrs. Cruz	Number patterns	Barangay School
8	Shop Owner Danny	Unit price comparison	Barangay Shop
9	Parent Rosa	Family budgeting	Barangay Home

Mission	NPC	Topic	Location
10	Banker Mr. Santos	Savings & interest	Barangay Cooperative

Level 2: CITY (Missions 11-20)

Mission	NPC	Topic	Location
11	Entrepreneur Carlos	Business profit	Business District
12	Accountant Lisa	Revenue projections	Finance Office
13	Logistics Manager Ben	Route optimization	Logistics Center
14	Sales Director Kim	Growth rates	Sales Office
15	Urban Planner Gina	Area division	Planning Office
16	Transit Manager Roy	Speed & distance	Transit Hub
17	Architect Maya	Height calculations	Architecture Firm
18	City Planner Tom	Population statistics	Planning Dept
19	Engineer Sarah	Material quantities	Engineering Office
20	Transport Chief Mike	Fare calculations	Transport Office

Level 3: PROVINCE (Missions 21-30)

Mission	NPC	Agency	Topic
21	Provincial Budget Officer	Budget Office	Budget allocation
22	Provincial Planning Officer	Planning Office	Revenue modeling
23	Provincial Engineer	Engineering Office	Infrastructure planning
24	Provincial Treasurer	Treasury	Cost analysis
25	Provincial Administrator	Admin Office	Policy coordination
26	Provincial Agriculturist	Agriculture Office	Operations optimization
27	Provincial Assessor	Assessor's Office	Land planning
28	Provincial Health Officer	Health Office	Resource management
29	Provincial Social Welfare Officer	Social Welfare	Investment analysis
30	Provincial Governor	Governor's Office	Strategic planning

Level 4: REGION (Missions 31-40)

Mission	NPC	Agency	Topic
31	RDC Director	Regional Development Council	Complex quadratics
32	NEDA Regional Director	NEDA	Polynomial division
33	DepEd Regional Director	DepEd	Function composition
34	DOST Regional Director	DOST	Advanced factoring
35	DTI Regional Director	DTI	Rational functions
36	DA Regional Director	DA	Exponential models
37	DOH Regional Director	DOH	Logarithmic analysis
38	DPWH Regional Director	DPWH	Matrix systems
39	DSWD Regional Director	DSWD	Sequence patterns
40	DILG Regional Director	DILG	Advanced inequalities

Level 5: NATIONAL (Missions 41-50)

Mission	NPC	Agency	Topic
41	DepEd Undersecretary	DepEd Central	Radical equations
42	DOST Secretary	DOST	Complex numbers
43	CHED Commissioner	CHED	Polynomial theorems
44	NEDA Director General	NEDA	Advanced matrices
45	National Scientist	NAST	Conic sections
46	PAGASA Administrator	PAGASA	Parametric equations
47	PSA Administrator	PSA	Advanced sequences
48	Senate Education Chair	Philippine Senate	Binomial theorem
49	DBM Secretary	DBM	Partial fractions
50	DepEd Secretary	DepEd Main Office	Mathematical proofs

Question System

Question Structure

Each of the 50 missions has a corresponding quiz question stored in `src/App.tsx` :

```
{  
  question: string;           // The math problem text  
  options: string[];         // Array of 4 multiple choice answers  
  correctAnswer: number;     // Index of correct answer (0-3)  
  explanation: string;       // Detailed solution explanation  
  steps: string[];           // Step-by-step solution breakdown  
  formula: string;           // Mathematical formula used  
  hints: string[];           // Helpful solving hints  
}
```

Sample Questions by Level

Level 1(Barangay) - Basic Algebra

Q1 (Vendor Mang Pedro): During a 20% off sale, a shirt costs ₱240. What was its original price?

- **Answer:** ₱300
- **Topic:** Percentage calculations

Q6 (Gardener Noel): Garden area $x^2 + 7x + 12 \text{ m}^2$. Factor to find dimensions.

- **Answer:** $(x + 3)$ by $(x + 4)$
- **Topic:** Factoring quadratics

Level 2 (City) - Intermediate Algebra

Q13 (Logistics Manager Ben): Revenue $R = -2p^2 + 80p$. What price maximizes revenue?

- **Answer:** ₱20
- **Topic:** Quadratic optimization

Q17 (Architect Maya): Budget [40, 30, 30]% of ₱500M. Education allocation?

- **Answer:** ₱200M
- **Topic:** Matrix operations

Level 3 (Province) - Advanced Algebra

Q23 (Provincial Engineer): Solve $\sqrt{2x + 5} = 7$

- **Answer:** $x = 22$
- **Topic:** Radical equations

Q28 (Provincial Health Officer): Solve $2x + y = 8$, $x - y = 1$

- **Answer:** $x = 3$, $y = 2$
- **Topic:** Systems of equations

Level 4 (Region) - Mastery Level

Q31 (RDC Director): Solve 3-variable system: $x + y + z = 12$, $2x - y + z = 5$, $x + 2y - z = 8$

- **Answer:** $x = 3$
- **Topic:** 3-variable systems

Q37 (DOH Regional Director): If $f(x) = 2x - 3$ and $g(x) = x^2 + 1$, find $(f \circ g)(2)$

- **Answer:** 7
- **Topic:** Function composition

Level 5 (National) - Expert Level

Q42 (DOST Secretary): Simplify complex number: $(3 + 2i)(1 - 4i)$

- **Answer:** $11 - 10i$
- **Topic:** Complex numbers

Q45 (National Scientist): Expand using Binomial Theorem: $(x + 2)^4$

- **Answer:** $x^4 + 8x^3 + 24x^2 + 32x + 16$
- **Topic:** Binomial theorem

Difficulty Progression

Missions 1-10: Basic arithmetic, percentages, simple equations

Missions 11-20: Intermediate algebra, linear equations, word problems

Missions 21-30: Advanced algebra, systems, quadratics

Missions 31-40: Mastery algebra, polynomials, functions

Missions 41-50: Expert algebra, complex numbers, proofs

Installation & Setup

Prerequisites

- **Node.js** 20.x or higher
- **npm or yarn**
- **Git**

Quick Start

1. Clone the repository

```
git clone <repository-url>
cd FIONA
```

2. Install dependencies

```
npm install
```

3. Set up environment variables

```
# Copy the template
cp ENV_TEMPLATE.txt .env

# Edit .env with your Supabase credentials
NEXT_PUBLIC_SUPABASE_URL=your_supabase_url
NEXT_PUBLIC_SUPABASE_ANON_KEY=your_supabase_anon_key
```

4. Run development server

```
npm run dev
```

5. Open browser

```
http://localhost:8080
```

Supabase Setup

1. Create a Supabase project at supabase.com
2. Run the SQL schema from `SUPABASE_SCHEMA.sql`
3. Copy your project URL and anon key to `.env`



Available Scripts

```
# Development
npm run dev          # Start dev server with logging
npm run dev-nolog    # Start dev server without logging

# Build
npm run build         # Production build with logging
npm run build-nolog   # Production build without logging
npm run export        # Export static site

# Mobile (Android)
npm run build:capacitor # Build for Capacitor
npm run mobile:sync     # Sync web assets to mobile
npm run mobile:open:android # Open Android Studio
npm run mobile:build:android # Build debug APK
npm run mobile:build:android:release # Build release APK
```

Development Workflow

1. **Make changes** to source files in `src/`
2. **Test locally** using `npm run dev`
3. **Build** using `npm run build`
4. **Test production build** locally
5. **Deploy** to hosting platform

Adding New Missions

1. Add NPC data to mission configuration
2. Add question to `src/App.tsx` questions object
3. Update collision data for NPC placement
4. Test mission flow and quiz functionality



Web Deployment

Vercel (Recommended)

```
npm run build  
# Deploy via Vercel CLI or GitHub integration
```

Netlify

```
npm run build  
# Deploy dist/ folder
```

Android APK Build

Quick Build

```
npm run build:capacitor  
cd android  
./gradlew assembleDebug
```

Release Build

```
npm run build:capacitor  
cd android  
./gradlew assembleRelease
```

APK location: `android/app/build/outputs/apk/`

See [APK_BUILD_GUIDE.md](#) for detailed instructions.

PWA Deployment

The game includes PWA support with:

- Service worker for offline functionality
- App manifest for installation
- Optimized icons (192x192, 512x512)
- Splash screens

See [PWA_SETUP_GUIDE.md](#) for details.

Features

Core Gameplay

- 50 unique missions across 5 government levels
- Interactive NPC dialog system
- Real-time quiz system with explanations
- Progressive difficulty curve
- Multiple game maps (Barangay, City, Province, Region, National)

Educational Features

- Comprehensive algebra curriculum (Grade 7 to advanced)
- Step-by-step solution explanations
- Formula references and hints
- Real-world problem applications
- Philippine government civic education

Game Systems

- **Leaderboard** - Global rankings and statistics
- **Shop System** - Purchasable items and upgrades
- **Collectibles** - Hidden items and achievements
- **Timer System** - Performance tracking
- **Secret Quests** - Hidden challenges
- **Collision Editor** - Custom map collision data

Technical Features

- **Cross-platform** - Web, Android, PWA
- **Responsive UI** - Works on all screen sizes
- **Cloud Save** - Progress saved via Supabase
- **Offline Support** - PWA capabilities
- **Performance Optimized** - Fast loading and smooth gameplay

UI/UX

- Modern, clean interface
- Intuitive controls
- Visual feedback and animations

- Accessibility considerations
 - Mobile-friendly touch controls
-

Documentation

Additional documentation available in the `documentation/` folder and root directory:

- `ARCHITECTURE.md` - System architecture overview
 - `GAME_FEATURES_DOCUMENTATION.md` - Detailed feature documentation
 - `LEADERBOARD_SETUP_GUIDE.md` - Leaderboard implementation
 - `SHOP_REWARD_SYSTEM_DOCUMENTATION.md` - Shop system details
 - `COLLISION_EDITOR_DOCUMENTATION.md` - Collision system guide
 - `SECRET_QUEST_SYSTEM_DOCUMENTATION.md` - Secret quest mechanics
 - `TIMER_SYSTEM_DOCUMENTATION.md` - Timer implementation
 - `APK_BUILD_GUIDE.md` - Android build instructions
 - `PWA_SETUP_GUIDE.md` - PWA configuration
-

Game Statistics

- **Total Missions:** 50
 - **Government Levels:** 5 (Barangay → National)
 - **Unique NPCs:** 50
 - **Quiz Questions:** 50
 - **Government Agencies Featured:** 13+
 - **Math Topics Covered:** 30+
 - **Supported Platforms:** 3 (Web, Android, PWA)
-

Learning Outcomes

Upon completing all 50 missions, players will have mastered:

Mathematics

- Basic arithmetic and percentages
- Linear equations and inequalities
- Quadratic equations and factoring

- Systems of equations (2 and 3 variables)
- Polynomial operations and theorems
- Functions and function composition
- Exponential and logarithmic functions
- Matrices and determinants
- Complex numbers
- Sequences and series
- Conic sections
- Mathematical proofs and reasoning

Civic Knowledge

- Philippine government structure
 - Roles of different government levels
 - Functions of major government agencies
 - Public service career paths
 - Government decision-making processes
-

Contributing

This is an educational project. For contributions or suggestions, please refer to the project maintainers.

License

MIT License - See [LICENSE](#) file for details.

Acknowledgments

- **Phaser** - Game engine framework
 - **Next.js** - React framework
 - **Supabase** - Backend infrastructure
 - **Philippine Government** - Structural inspiration for educational content
-

Support

For technical issues or questions, refer to the documentation files or contact the development team.

Version: 1.2.0

Last Updated: December 2024

Platform: Web | Android | PWA

Target Audience: Students (Grade 7+), Educators, Math Learners

Algebra Adventure - Making Math Fun Through Civic Engagement 🎮📐🇵🇭