

# BINARY SPECTRUM

## Inclusive CS Learning through Play



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### Overview

*Binary Spectrum* is an iPad app that teaches foundational computer science (CS) concepts to middle school learners through mini-games. It addresses two challenges in CS education:

- Gender inequality, through inclusive design and storytelling.
- Classroom diversity, through adaptive challenges for varied skill levels and learning paces.

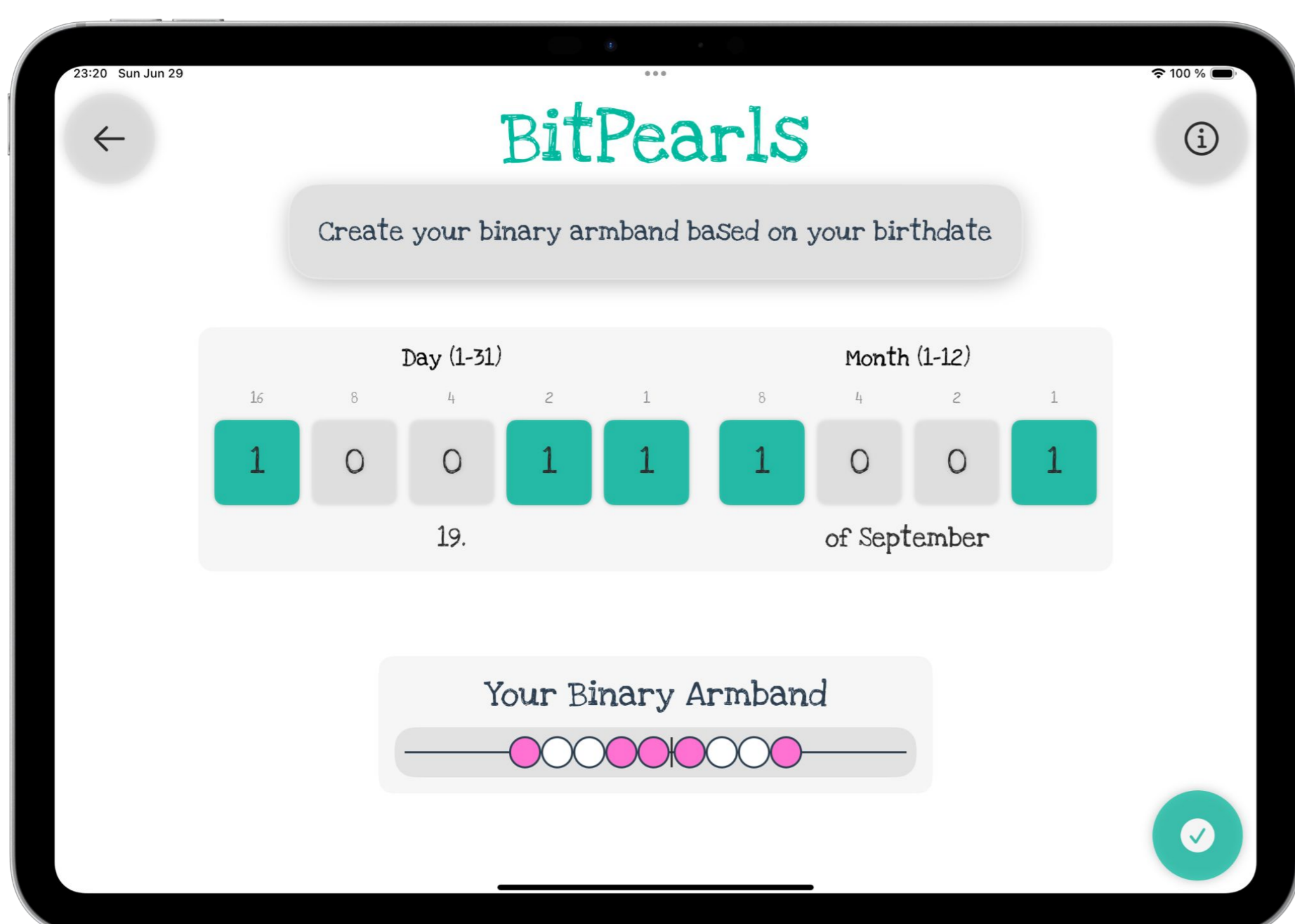


Main Menu

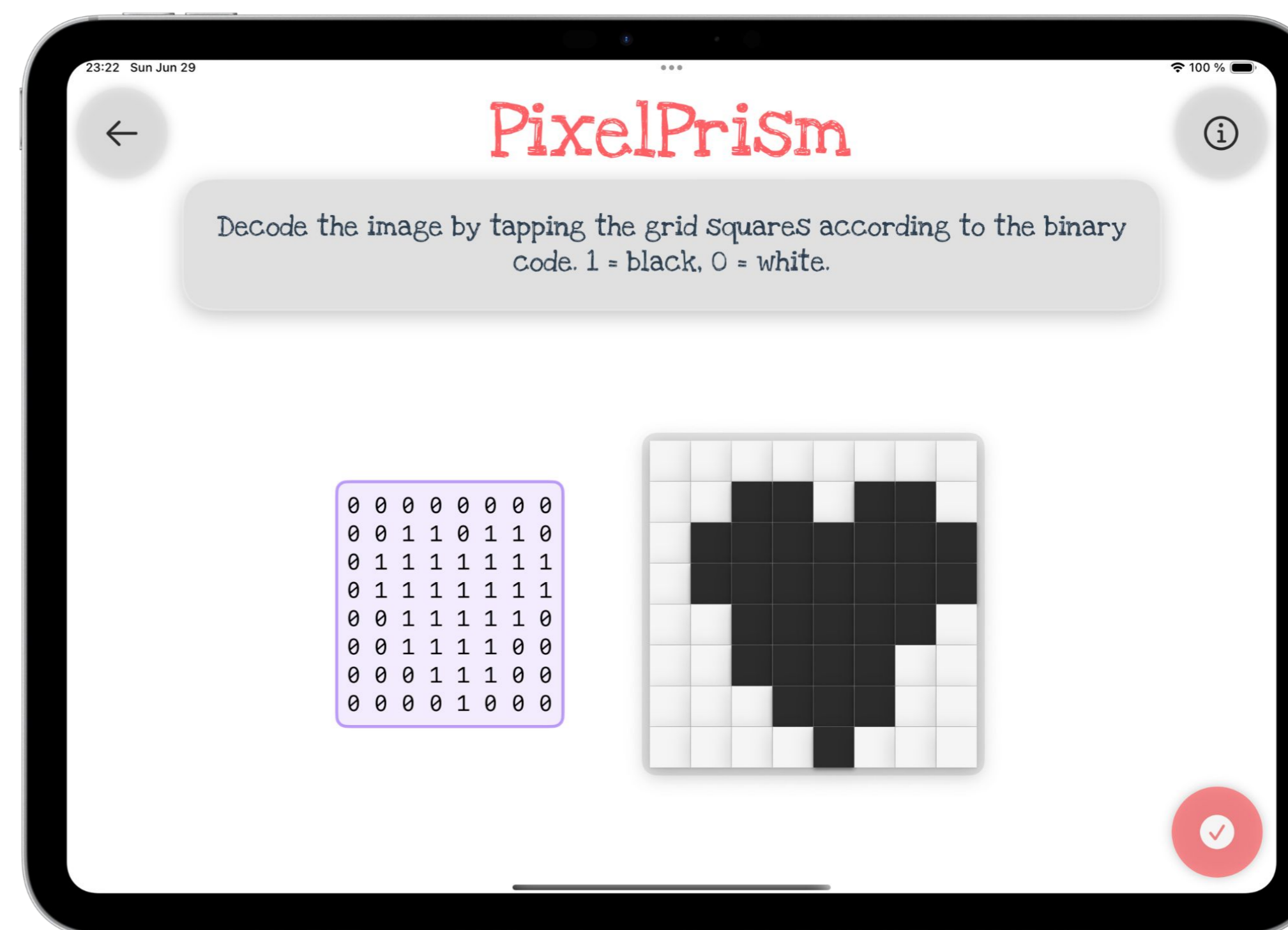
### Design Goals

- **Gender-Sensitive Design:** Uses neutral visuals, narrative framing, and diverse role models (Alex, Pixie, Iris) to engage all genders.
- **Adaptive Learning:** Offers modular challenges, adjustable difficulty, and optional guidance.
- **Learning Through Play:** Builds on CS Unplugged principles to turn abstract ideas into interactive tasks

### Mini-Games



BitPearls Mini-Game

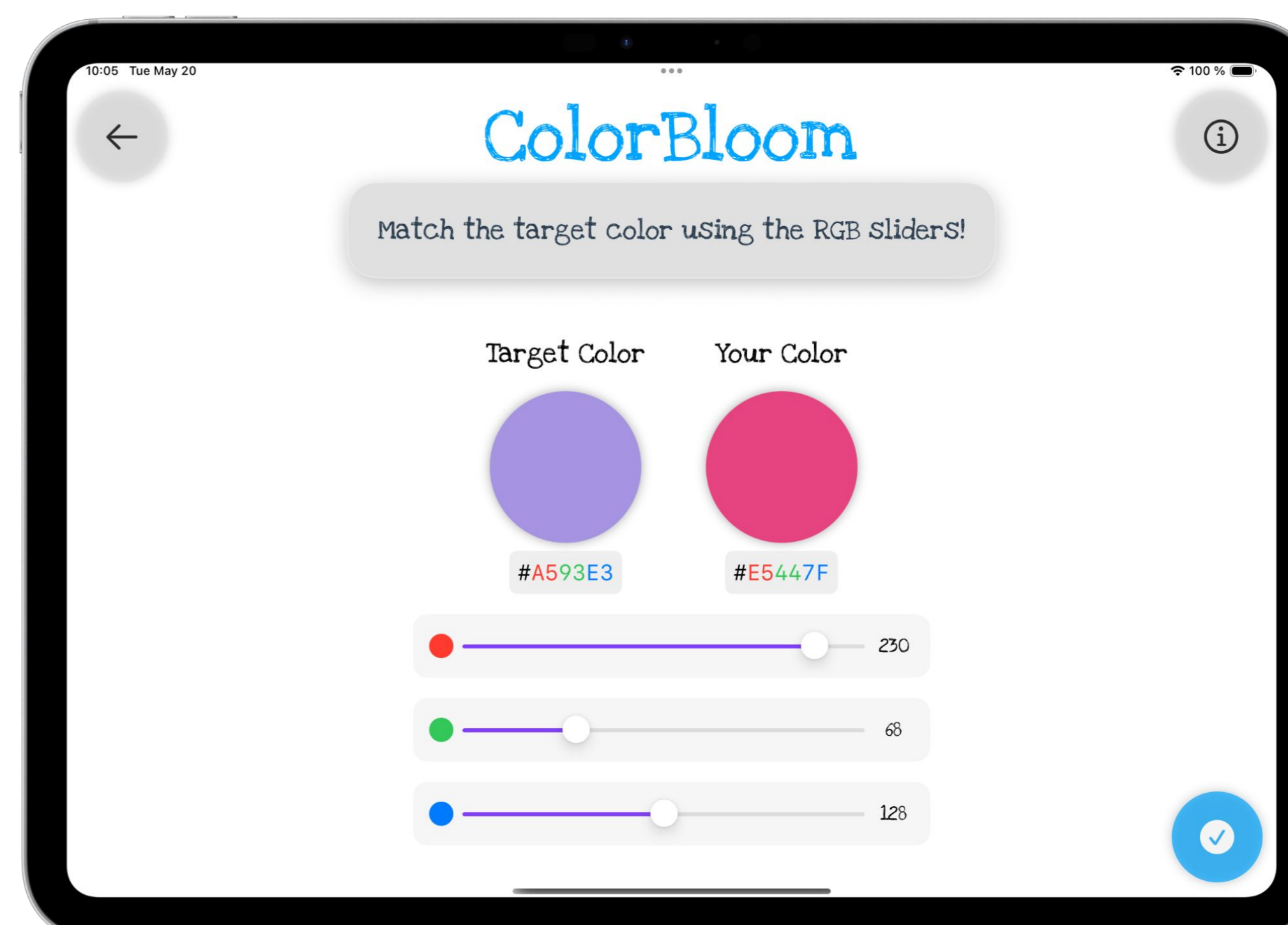


PixelPrism Mini-Game

**BitPearls** - Convert decimal to binary and create personalized "binary armbands."

**PixelPrism** - Paint with pixels to explore image representation and compression.

**ColorBloom** - Mix digital colors using RGB and hex codes in creative challenges.



ColorBloom Mini-Game

Each game runs offline, supports English, German, and Brazilian Portuguese, and fits into 15–20 minute sessions. Features include in-game tips, achievements, and guided progression.

### Impact & Conclusion

*Binary Spectrum* introduces core CS concepts through inclusive, game-based learning. It focuses on conceptual understanding over coding and uses digital play to make abstract ideas tangible.

A pilot with six middle school students showed strong engagement, especially with creative tasks like *PixelPrism*. Feedback supports the app's appeal and highlights areas for refinement.

By digitizing unplugged activities, *Binary Spectrum* offers accessible, inclusive pathways into computing.



12<sup>th</sup> ACM Celebration of Women in Computing: womENCourage™  
Braşov, Romania  
17-19 September, 2025  
Theme: Computer Science: a Catalyst for Educational Change

