



Quantum Adventure

— Gamifying Quantum Concepts for High School Learners

This project translates five core quantum concepts—qubit, quantum state, superposition, entanglement, and measurement—into a board game format. By combining familiar mechanics with educational design, the game aims to enable high school students to intuitively grasp abstract phenomena through play, strategy, and interaction.

Q-JAM SUMMER CAMP

TIME: 2025.5-2025.8

A quantum-themed interdisciplinary summer camp: bridging science, design, and education.

I participated in the Q-JAM Camp as a content contributor, responsible for organizing quantum knowledge, summarizing core concepts (superposition, measurement, entanglement), and developing a structured mind map to support idea generation for quantum game design.

Category
Education Program

Role
Content Contributor
Mind Map Designer

Project Status
Completed and Documented



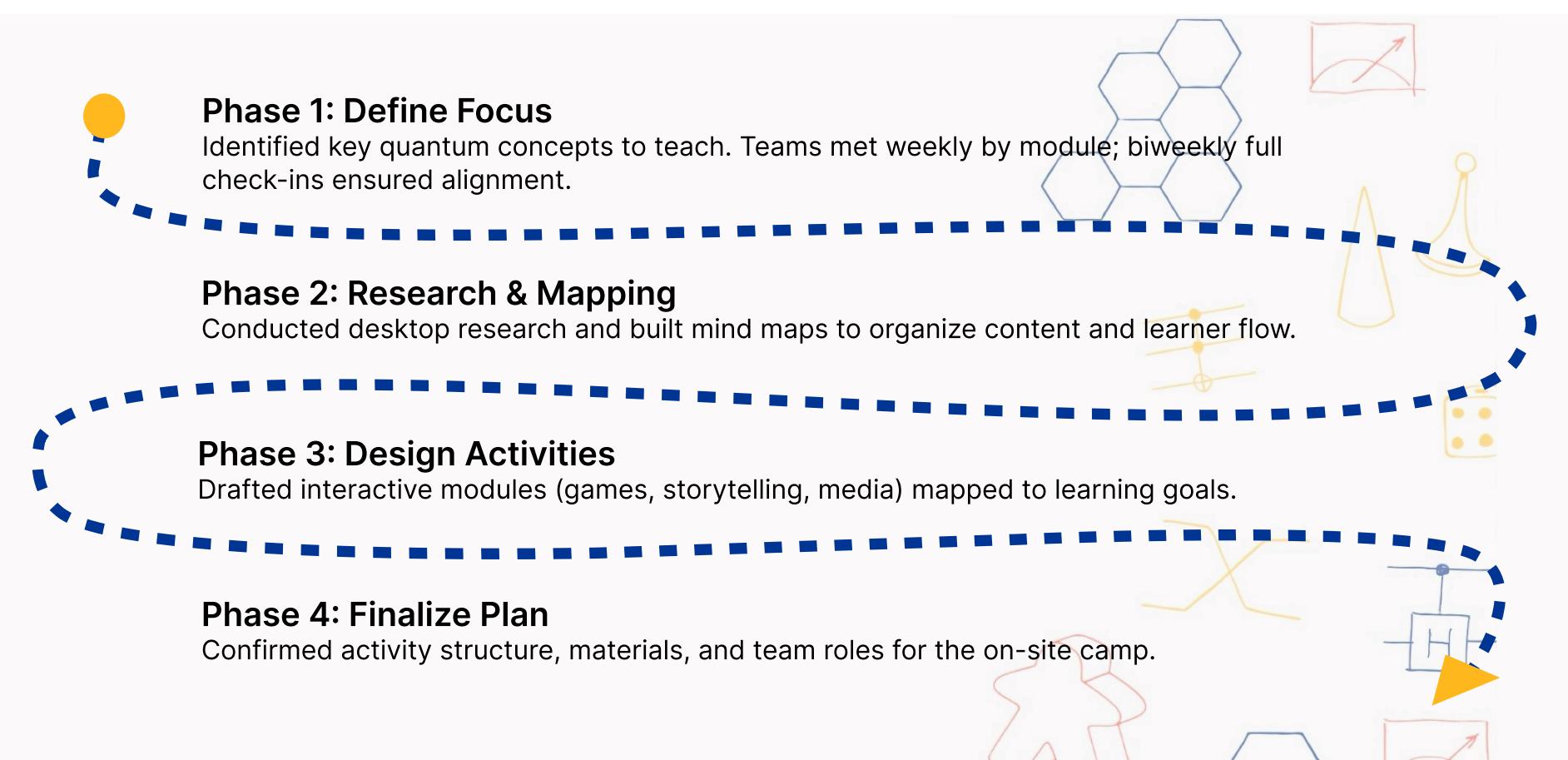
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Content Contributor at Q-JAM Summer Program



Milestones



Personal Reflection

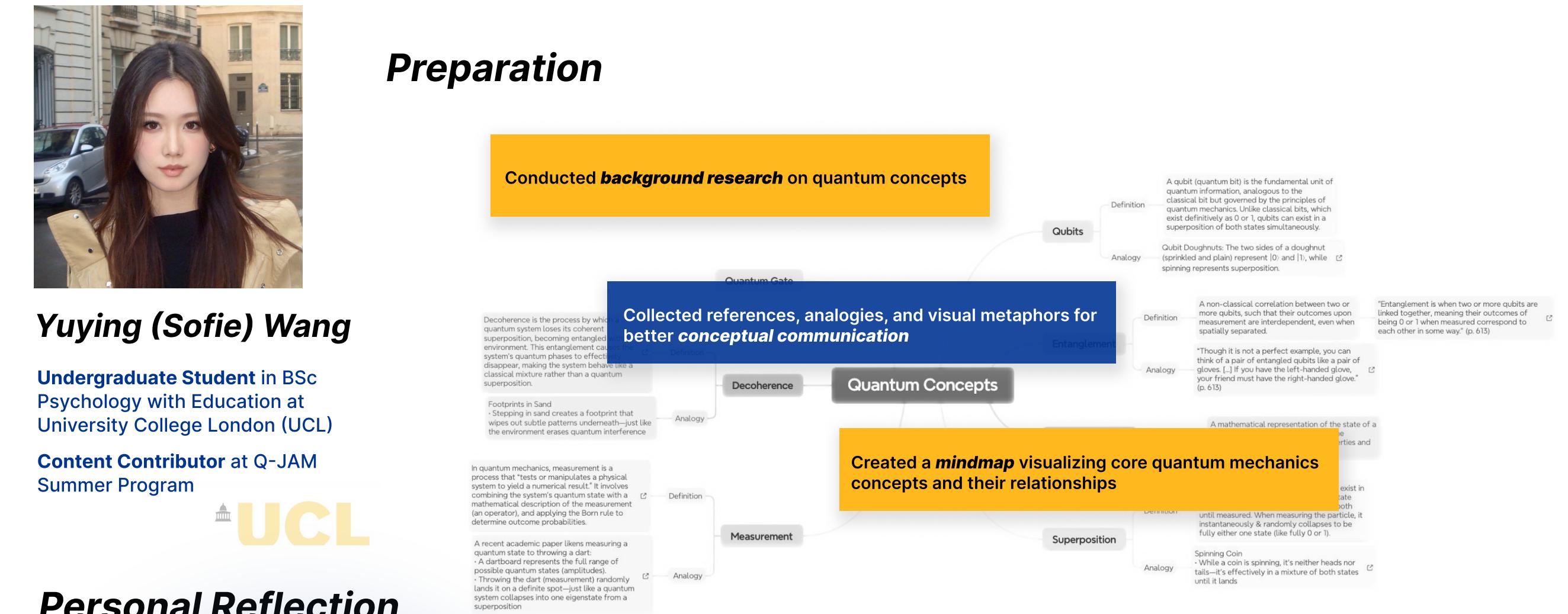
How to make quantum concepts tangible through play?



“ Analyzed quantum concepts and created structured mind maps during Q-JAM

“ Identified the challenge: key ideas like superposition and entanglement remain abstract for learners

“ Decided to design a gamified learning tool to help high-schooler intuitively grasp quantum mechanics

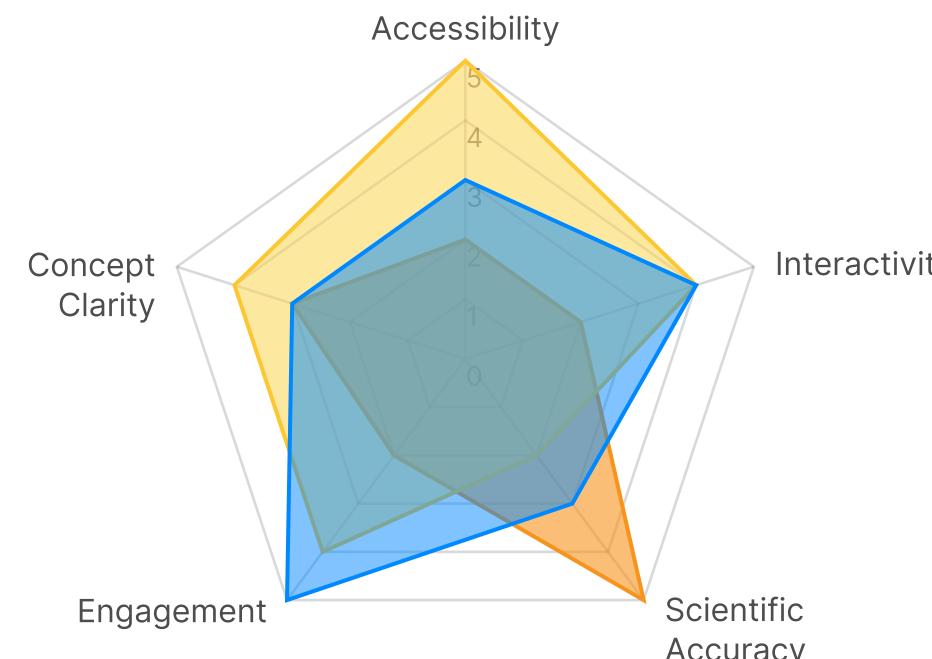


COMPETITIVE ANALYSIS

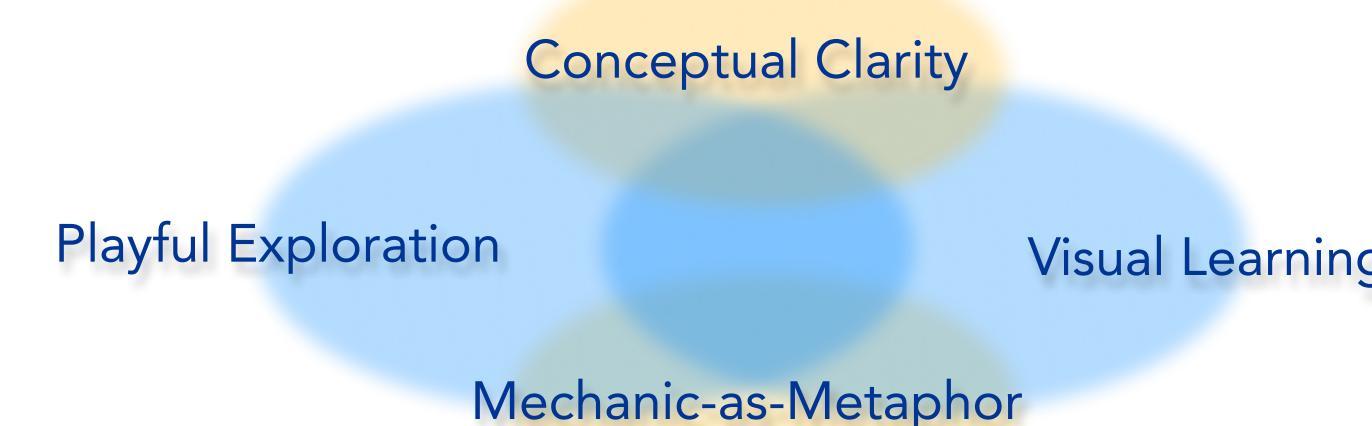
To identify design gaps and opportunities, existing quantum educational tools and games are analyzed.

	quEDU	Quander Games	Quantum
Interface			
Features	Typically teacher-led, limited student interaction	Visual, symbolic, drag-and-drop interface; no math required	A fast-paced strategy game where dice represent ships with variable powers depending on their value
Pros	Offers real experimental results, not just simulation	Highly visual and metaphor-driven; reduces abstractness	Strong graphic design, good physical components, well-balanced rules
Cons	High cost and complexity, limited accessibility	Very metaphorical—limited direct connection to scientific terms or formalism	May be overwhelming for students under 13 or unfamiliar with modern board games

Conclusion



Design Opportunity

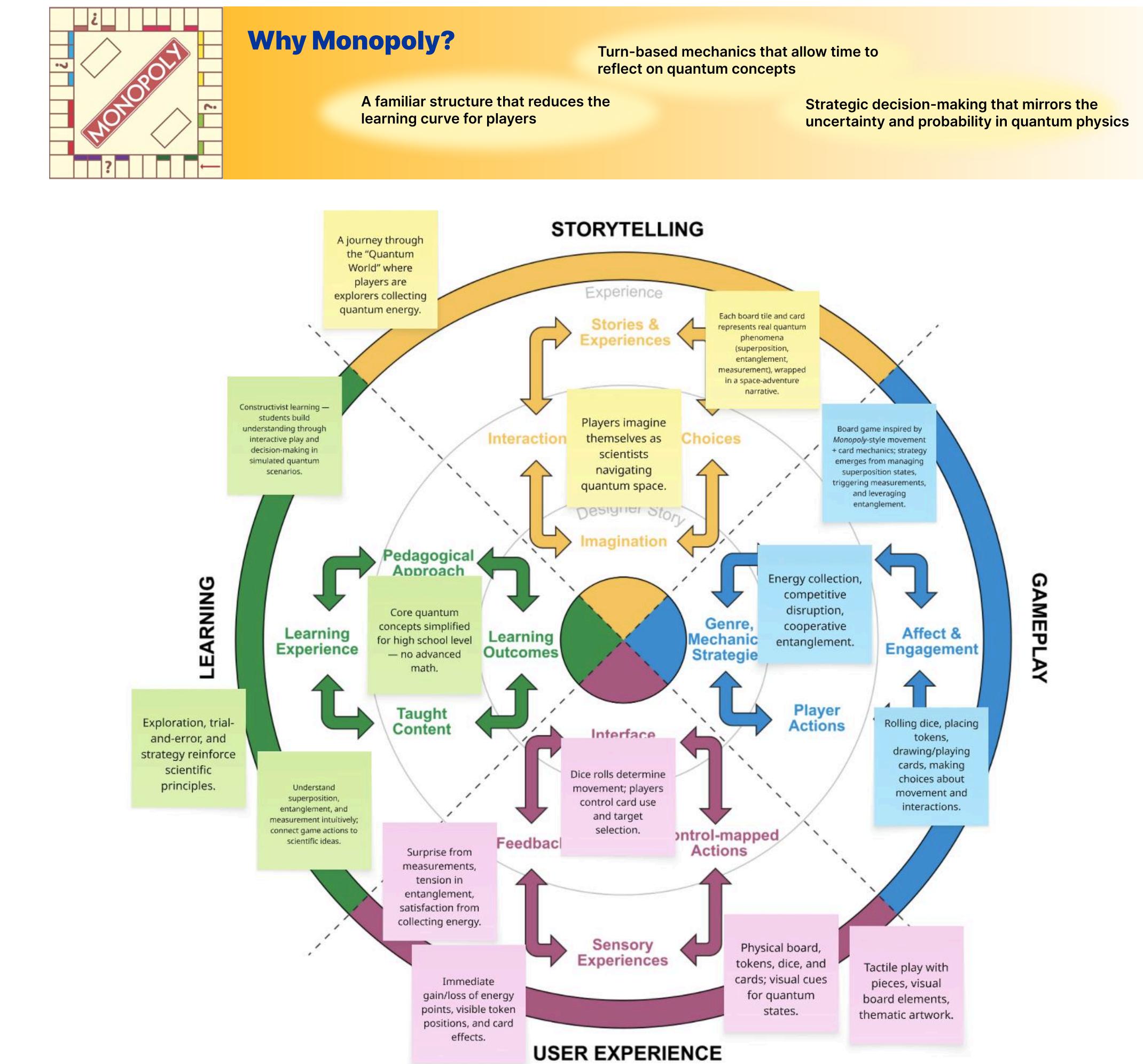


Integrating familiar board game structures with core quantum ideas opens up a playful, hands-on way to explore abstract quantum concepts through visible, interactive game mechanics.

● quEDU ● Quander Games ● Quantum

IDEATION

To make complex quantum concepts approachable, the game adopts a grid-based progression system inspired by *Monopoly*.



Brainstorming By Serious Game Design Methodology

CONCEPT

An Educational Board Game Designed To Help High School Students Explore Quantum Concepts

Brainstorming Conclusion



Game Type



A strategy-based serious game that merges classic board game mechanics with quantum physics concepts for playful STEM learning.



Help high school students *intuitively grasp five core quantum concepts* through interactive play, fostering curiosity and confidence in science.

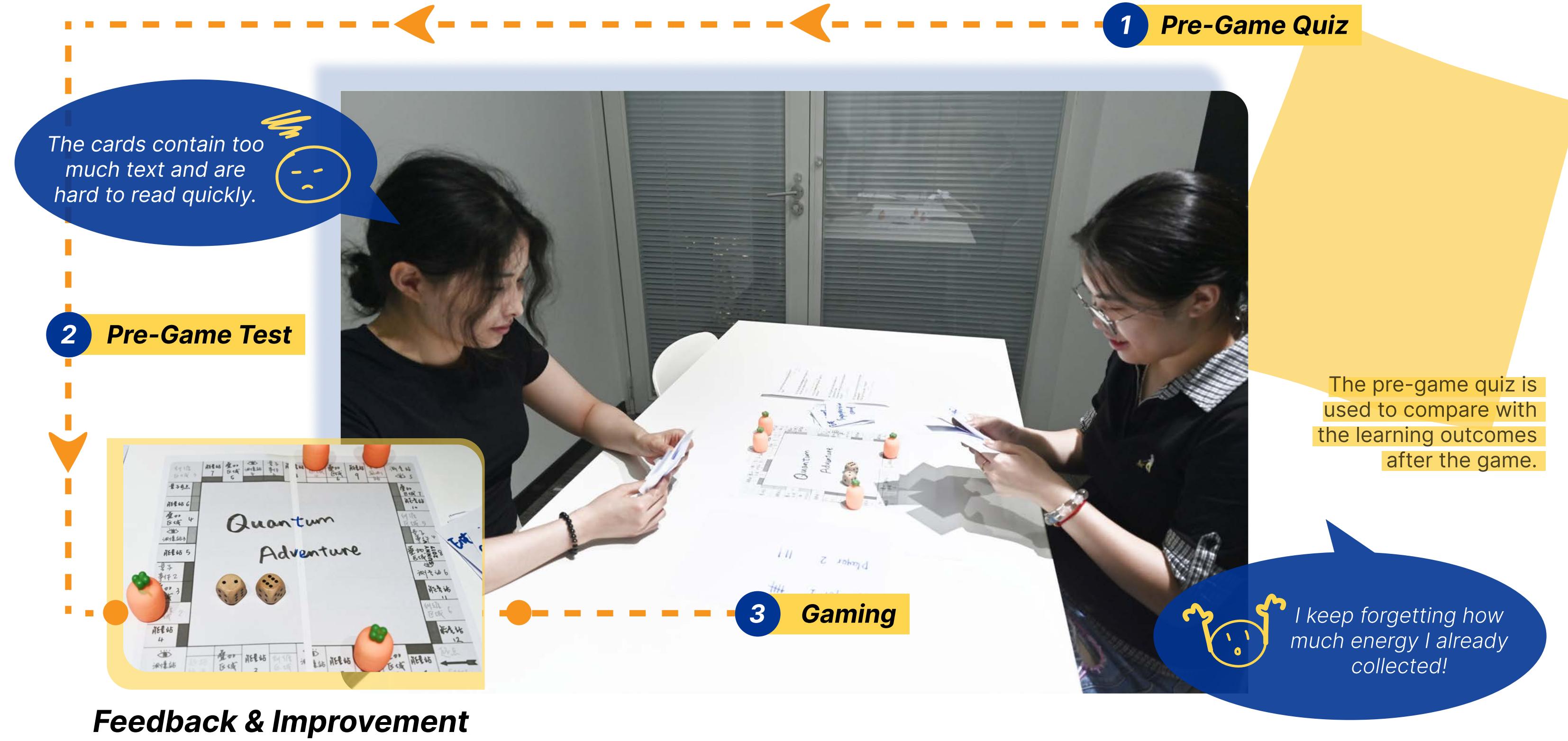


Set in a *fictional “Quantum World”* where players *explore, collect energy, and interact with quantum phenomena* represented by board spaces and cards.



Target User

High school students aged 15–18 with an interest in science, games, and problem-solving, but no prior physics background.



Card Layout: Text-heavy design reduced readability



Simplify with larger icons and concise keywords

Energy Tracking: Players often lost track of collected energy



Introduce energy tokens on a personal tracker board

Token Design: Tokens were perceived as plain and lacking appeal



Redesign with custom pieces reflecting quantum superposition

ITERATION

the game evolved from concept sketches to a playable system that links quantum ideas with strategy

Thinking Process

Mapped **core quantum ideas** onto **concrete board actions**.

Focused on **balancing scientific** meaning with **strategic gameplay value**.

Simplified card text into icons + keywords while keeping **conceptual clarity**.

Refined board layout to maintain rhythm and variety across 40 spaces.

Unified visual language across tokens, cards, and tiles for accessibility.

Used **playtesting as feedback** loops, observing both confusion and excitement.

Iteration shaped a system where **learning goals** and **fun mechanics** reinforce each other.

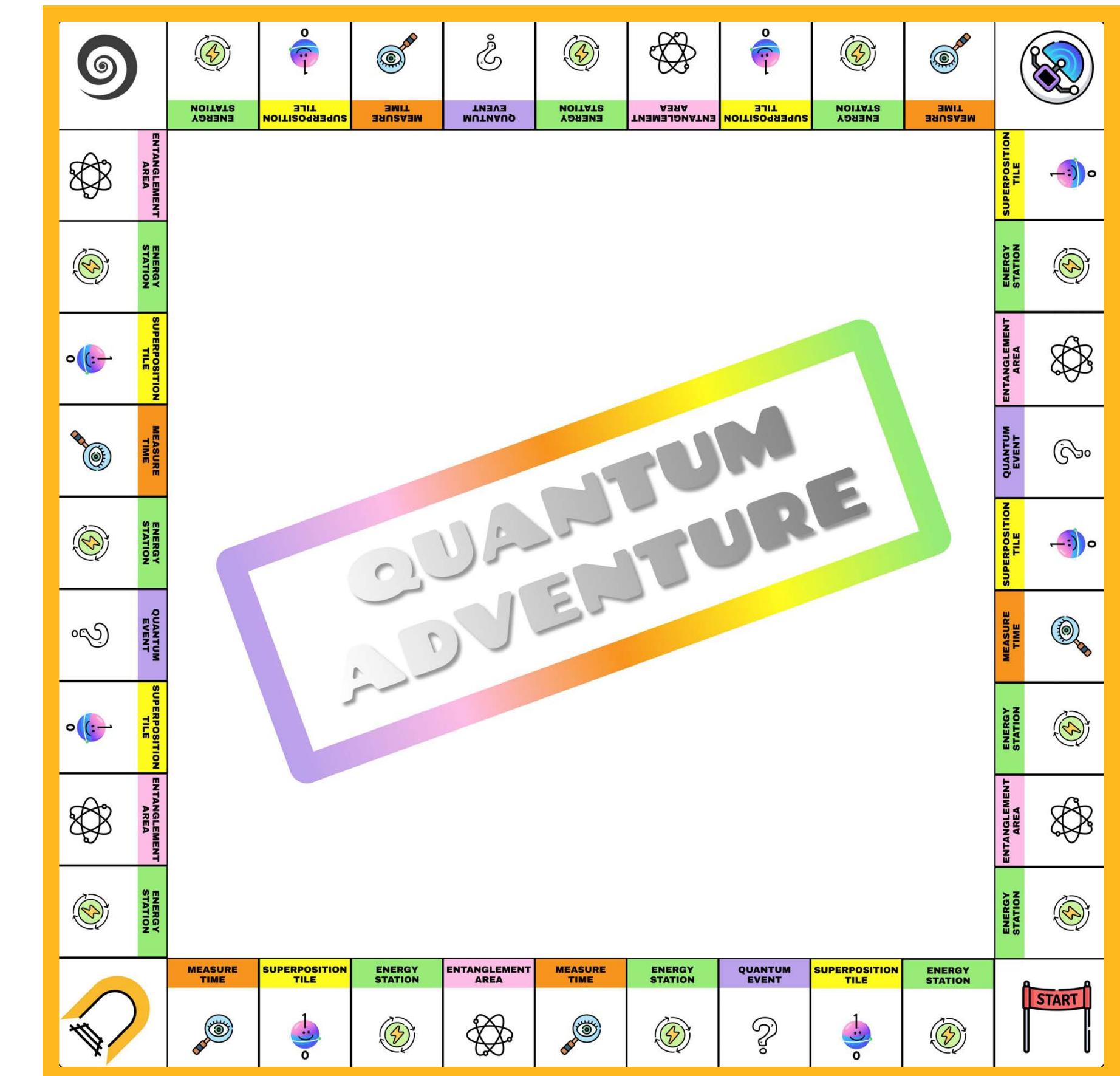


Card System

6 types of cards guide strategy and surprise.

Each card **connects directly to a quantum concept** (superposition, entanglement, measurement, etc.).

Designed with **icons + colors** for fast recognition.



Game Board

40 squares combining energy, superposition, entanglement, and measurement spaces.

Each tile **translates a quantum idea into gameplay mechanics**.

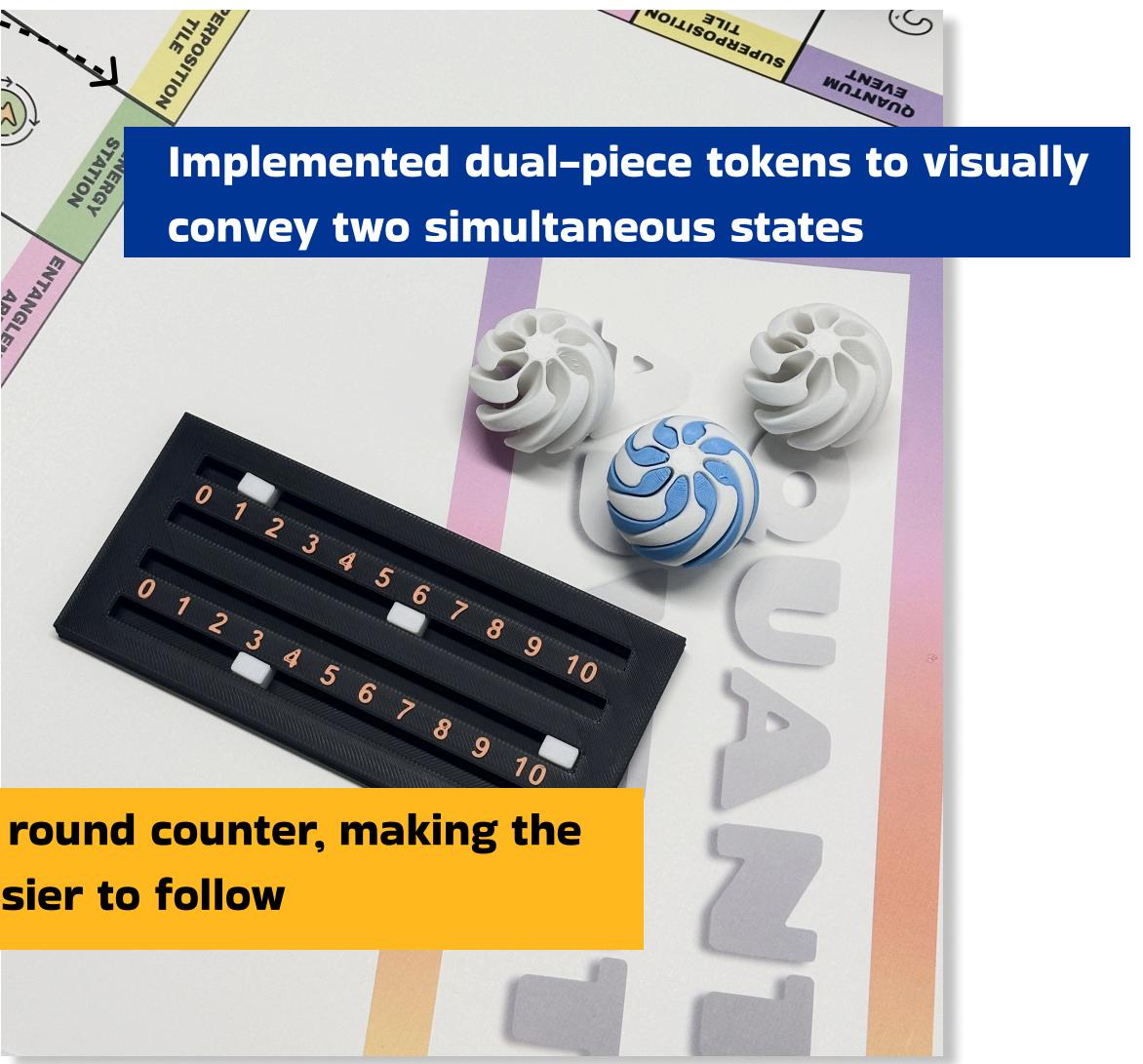
Balanced layout ensures progression, strategy, and unpredictability.

Comparison with Early Prototype

Prototype Issue

The concept of superposition was hard to visualize when using identical tokens

Players often forgot progress because there was no way to track loops



Reaction while testing the final version

- “Entanglement added a fun twist – I liked how I sometimes benefited from another player’s move, but also had to deal with their risks.”



- “The Quantum Event cards were my favorite part – unpredictable but still balanced, like real quantum uncertainty.”

- “The combination of cards and board effects gave me multiple ways to play – I felt in control even with randomness involved.”

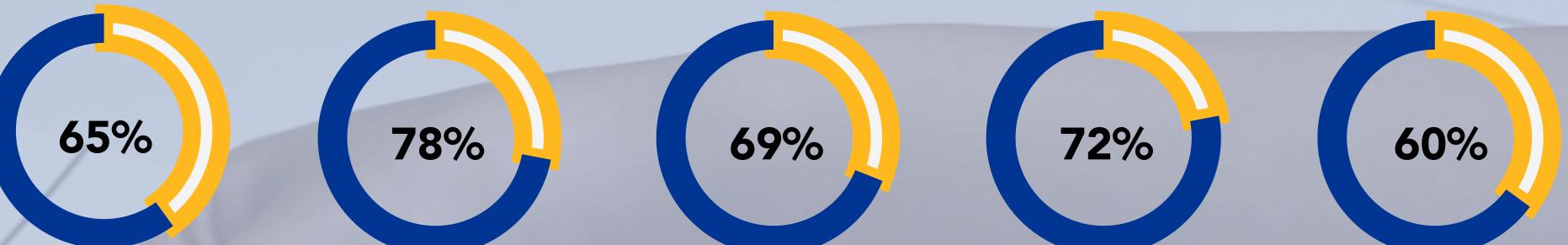


Final Work

1 Setting Up



During the final game test, participants find it easier to connect terms to quantum logic and strategic gameplay, indicating better understanding towards each 5 quantum concepts



3 Board Spaces

Superposition Tile

- Grants a Superposition Shield (immune to one measurement) — modeling how a system can remain in superposition without collapsing until observed.

Entanglement Area

- Entangle with another player for 3 turns, sharing gains and losses — mirroring quantum entanglement where two particles' states are linked

Quantum Event

- Draw a random event card with boosts or penalties — reflecting quantum fluctuations and unpredictability in physical systems.

Measure Time

- Roll 1 die to keep one token and remove the other — simulating wavefunction collapse, where measurement forces one definite outcome.

Energy Station

- Gain +1 energy point for each token — representing how particles store and exchange quantum energy in different states.