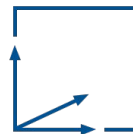


# Developing a Serious Game to teach Mathematics

Laura Marsoner

23.02.2022



Final: Bachelor Informatics: Games Engineering

Supervisor: Prof. Gudrun Klinker, Ph.D.

Advisor: Dr. David A. Plecher

# Introduction / Motivation

- Serious games in education
- Benefits:
  - playful learning
  - learning effectiveness
  - learning motivation
- Problems:
  - focus on serious part
  - fun factor neglected
  - hard competition
- Focus on entertainment



# Goals of this Thesis

- Serious Math Game
- Math content
  - immersive
  - different ways
  - optional but rewarding
- Increase
  - motivation to engage with math
  - long term learning success



# Research Question(s)

What proven **design principles** can be applied to make the game more **interesting** and **motivate** players to engage with serious content?

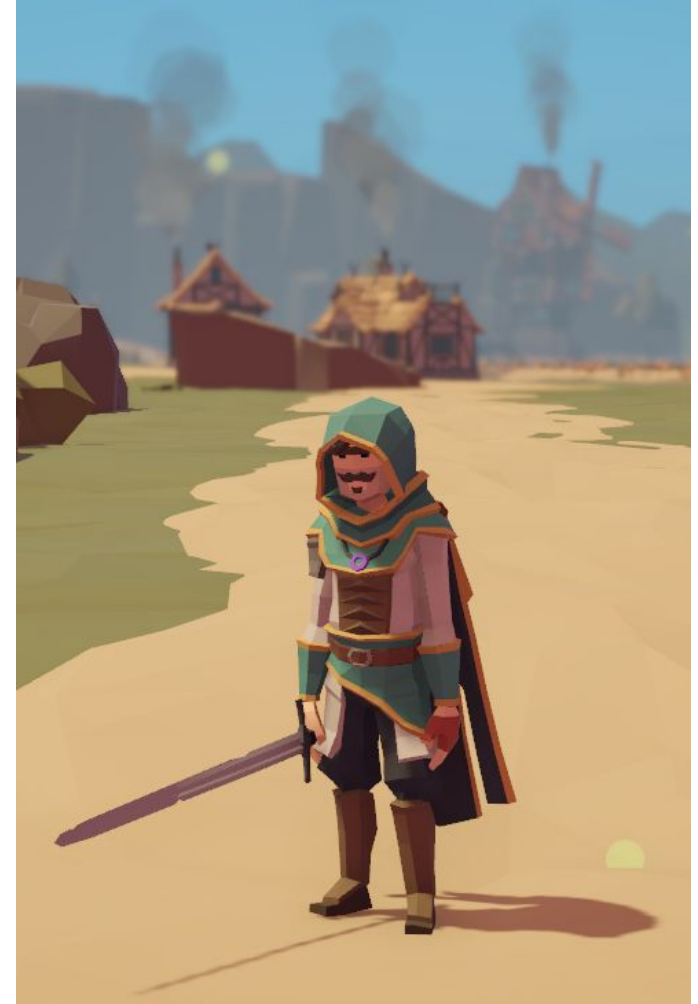
In what **ways** could **math** be **integrated** into the game to make it engaging and offer different options for **different types** of **players**?

How is the **game experience** and the **inclusion of mathematical** content perceived by players?

To what **extent** is this serious game, which incorporates mathematical content on a voluntary basis, able to **motivate** players **to engage with mathematical** topics?

# Theoretical Background

- Design principles
  - Hero & narrative
  - Immersion & flow
  - Intrinsic & extrinsic motivation
- Math Content
  - Secondary education
  - 6th to 8th grade
  - Official curriculum of South Tyrol
  - Corresponds to “LehrplanPlus”



# Related Work

- No specific game found
- Most for primary education
- Math Games
  - Prodigy Math
  - Mathstation
- Action RPG
  - Diablo Immortal

# Game Concept: Kingdom of Math

- Overview
  - Action RPG
  - Unity 5
  - 3rd person single-player
  - PC
  - Students aged 10-14
  - Medieval fantasy world
- Design Pillars
  - math included immersively
  - math voluntarily playable
  - game/combat fun



# Game Concept: Math Content

- Chests
- Item Upgrades
- Shops
- Quests





# Game Concept: Math Content

- **Chests**
  - Solve Riddles
  - 3 difficulties
  - Corresponding loot
  - Intrinsic & extrinsic motivation
- Item Upgrades
- Shops
- Quests



# Game Concept: Math Content

- Chests
- **Item Upgrades**
  - Increase stats
  - Create Equations
  - Mental arithmetic
  - Optimize stats
- Shops
- Quests



# Game Concept: Math Content

- Chests
- Item Upgrades
- **Shops**
  - Different types
  - Buy & sell items
  - Prices shop dependent
  - Feeling for economy
- Quests



# Game Concept: Math Content

- Chests
- Item Upgrades
- Shops
- **Quests**
  - Side quests
  - Content corresponds to topic of level
  - Promote immersion
  - Recognize & understand problems



# Evaluation

- User study
  - Player experience
  - Included math content
- Participants
  - 6: 3 male, 3 female
  - Grades 6 - 8
  - Ages 10 - 14
- Questionnaire
  - Demographic questions
  - Game Experience Questionnaire (GEQ)
  - 15 content questions

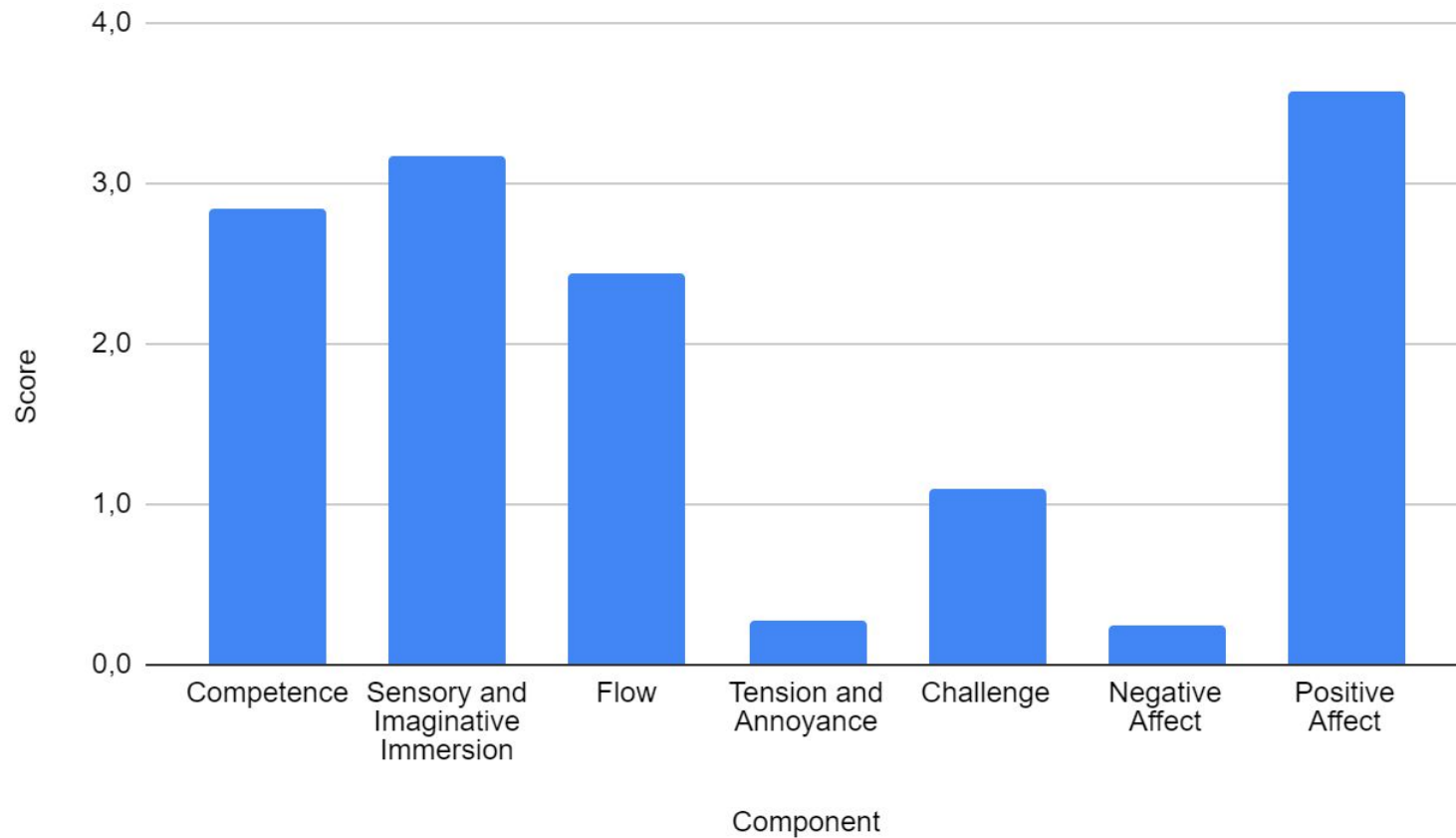


# Evaluation: Procedure



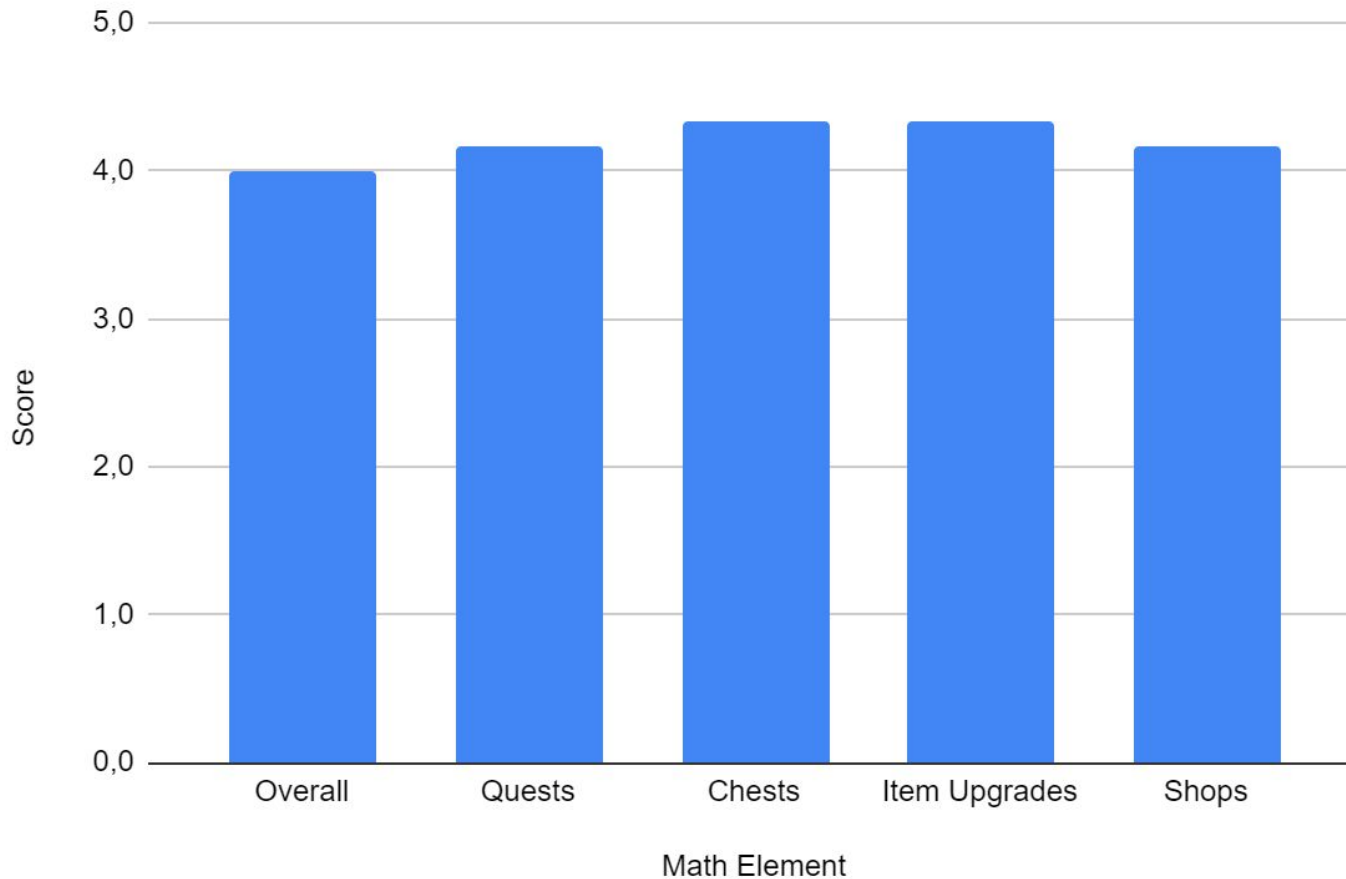
# Results/Discussion

## GEQ Evaluation



# Results/Discussion

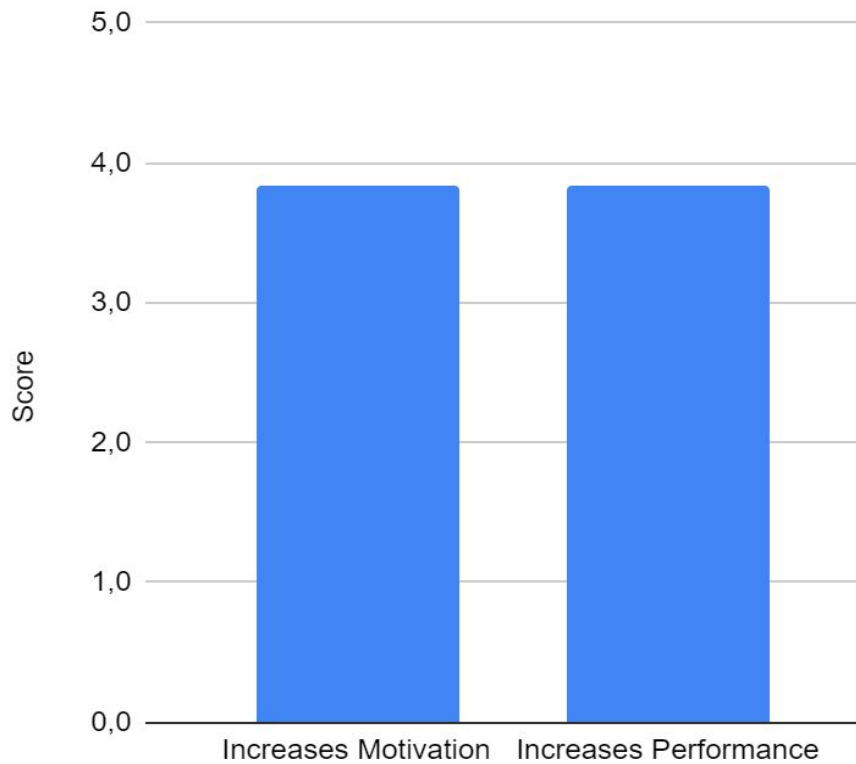
## Enjoyment of Math Elements



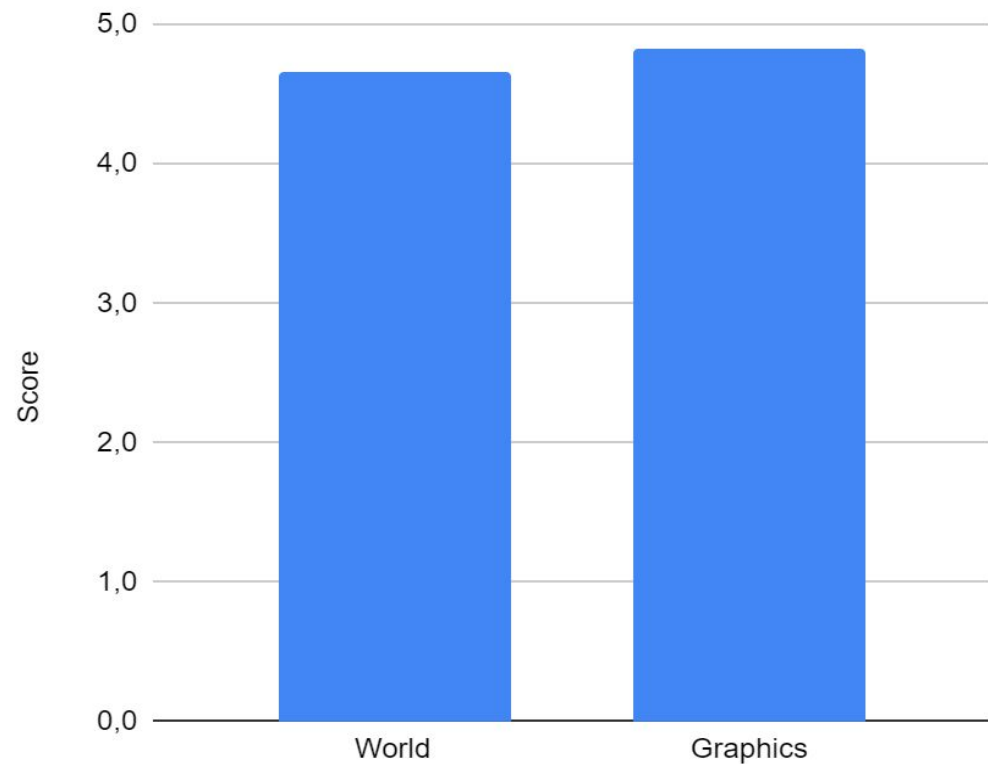


# Results/Discussion

## Motivation & Performance



## Enjoyment of Game World and Style



# Results/Discussion

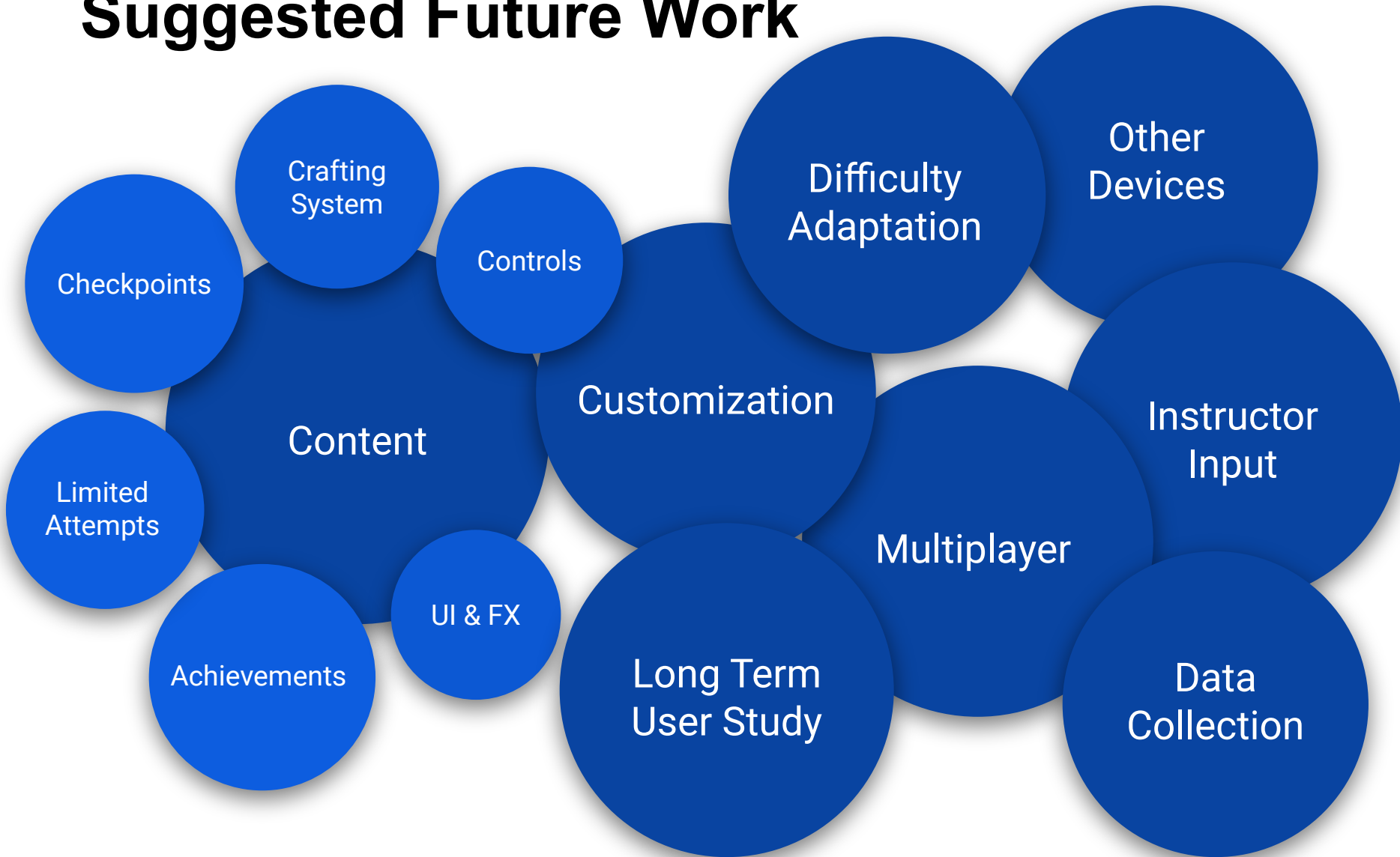
- Different playstyles
- Free-time
- Small number of participants -> tendency
- Long-term study needed

# Results/Discussion

- Liked:
  - fighting against enemies
  - graphics
- Disliked:
  - camera and movement
  - long way to run after respawn
- Wishes:
  - more math content and levels
  - multiplayer mode
  - skins
  - possibility to play with controller



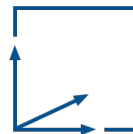
# Suggested Future Work



# Conclusion

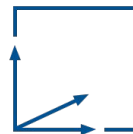
- Design principles
  - Hero & story
  - Immersion & flow
  - Intrinsic & extrinsic motivation
- Mathematical content integration
  - Chests, Item Upgrades, Shops, Quests
- Positive game experience
- Motivated to engage with math

# Questions?



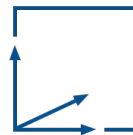
# Gameplay Trailer

[https://www.youtube.com/watch?v=zHgLsDbrP3M&ab\\_channel=LukasPichler](https://www.youtube.com/watch?v=zHgLsDbrP3M&ab_channel=LukasPichler)



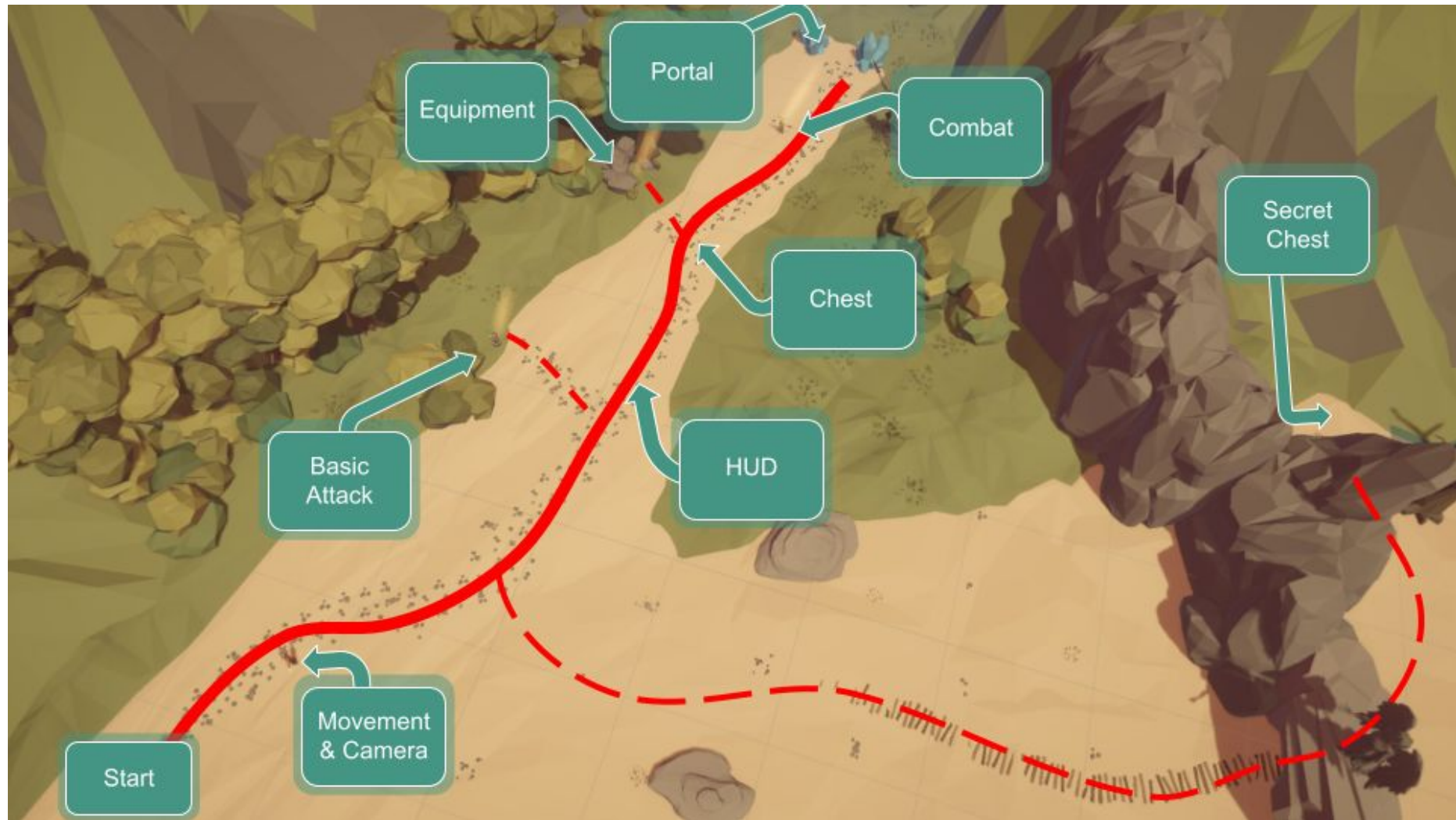
# Available on Itch.io

<https://lauramarsoner.itch.io/kingdomofmath>

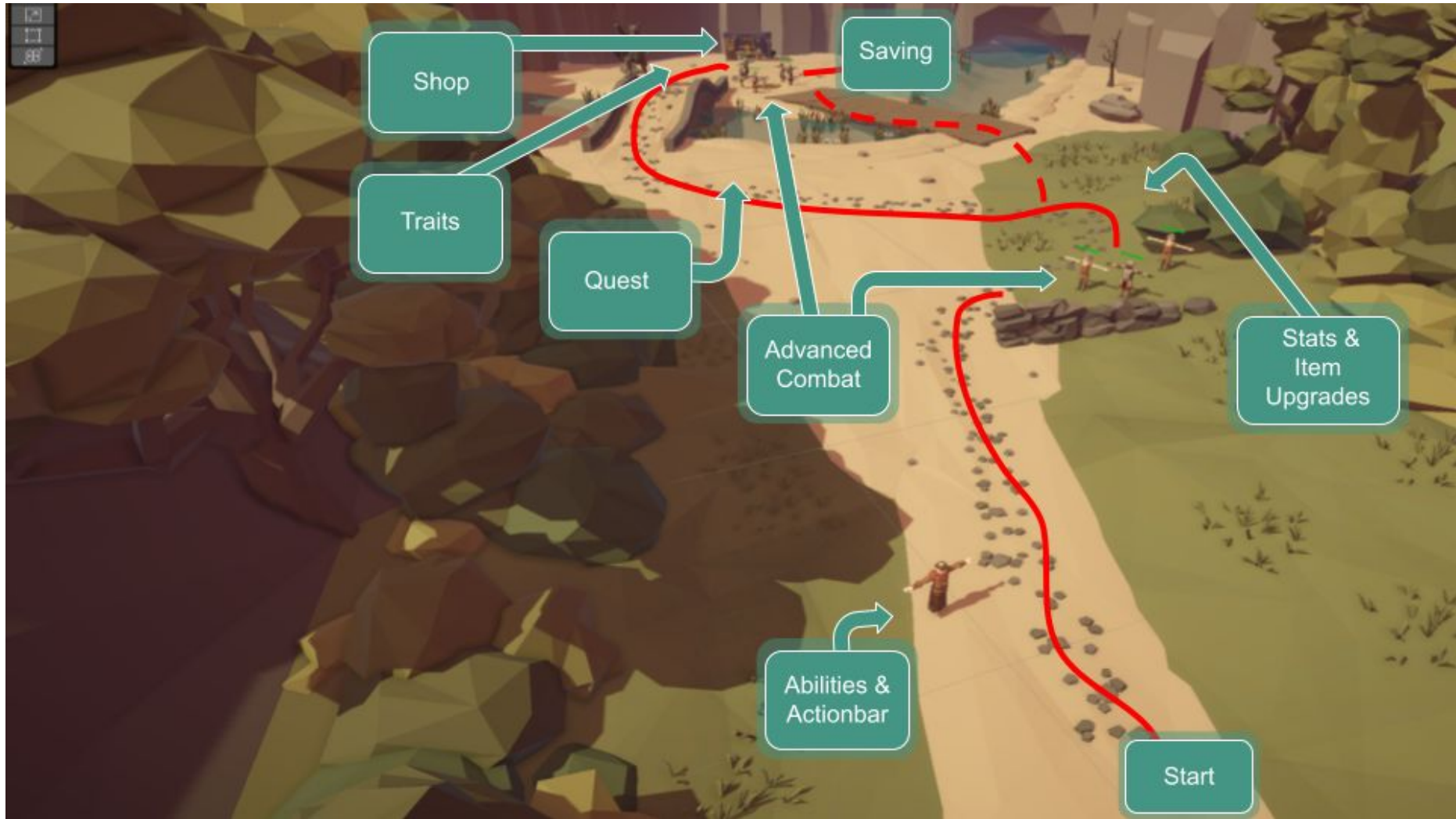




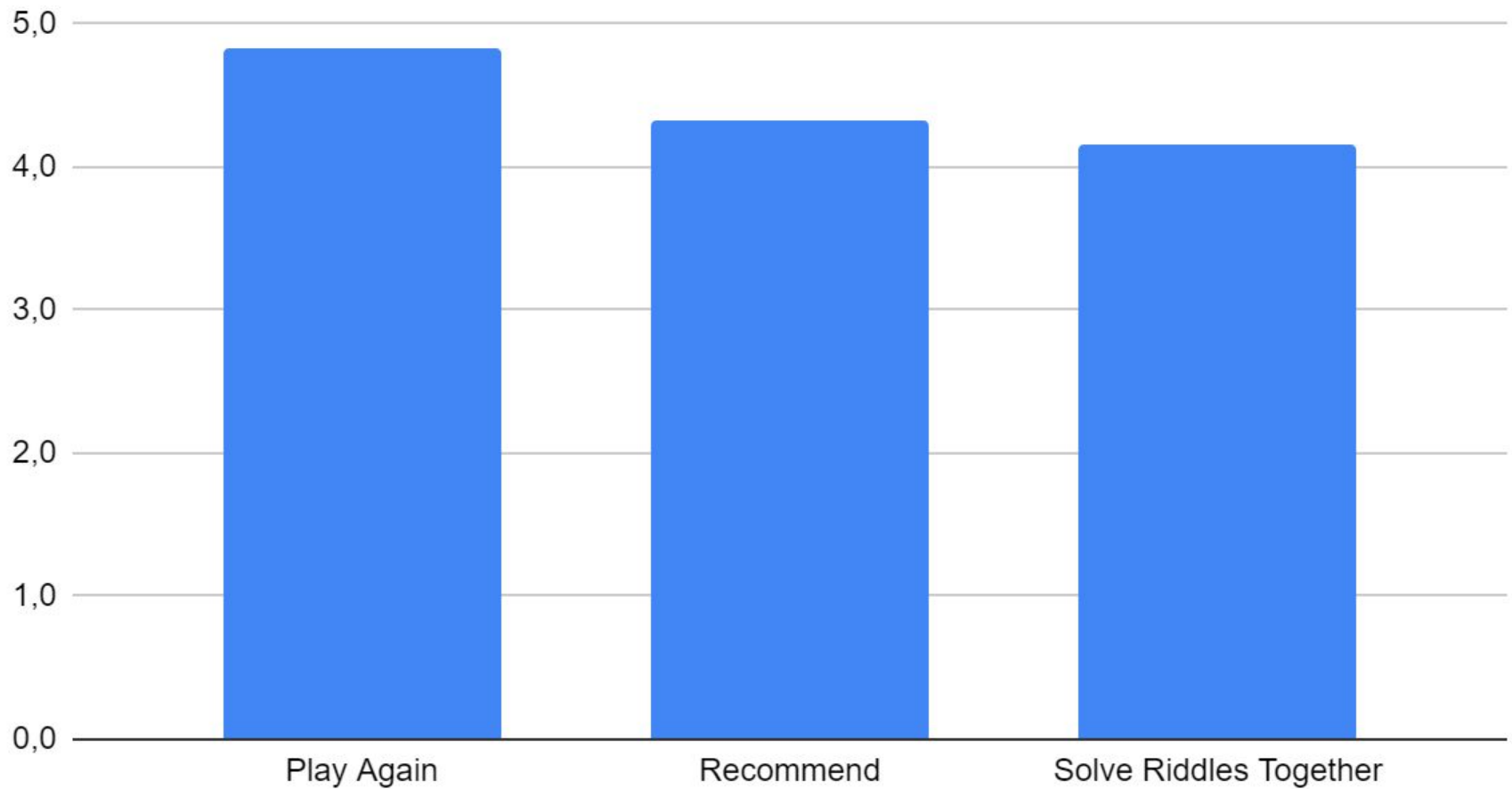
# Bonus: Tutorial



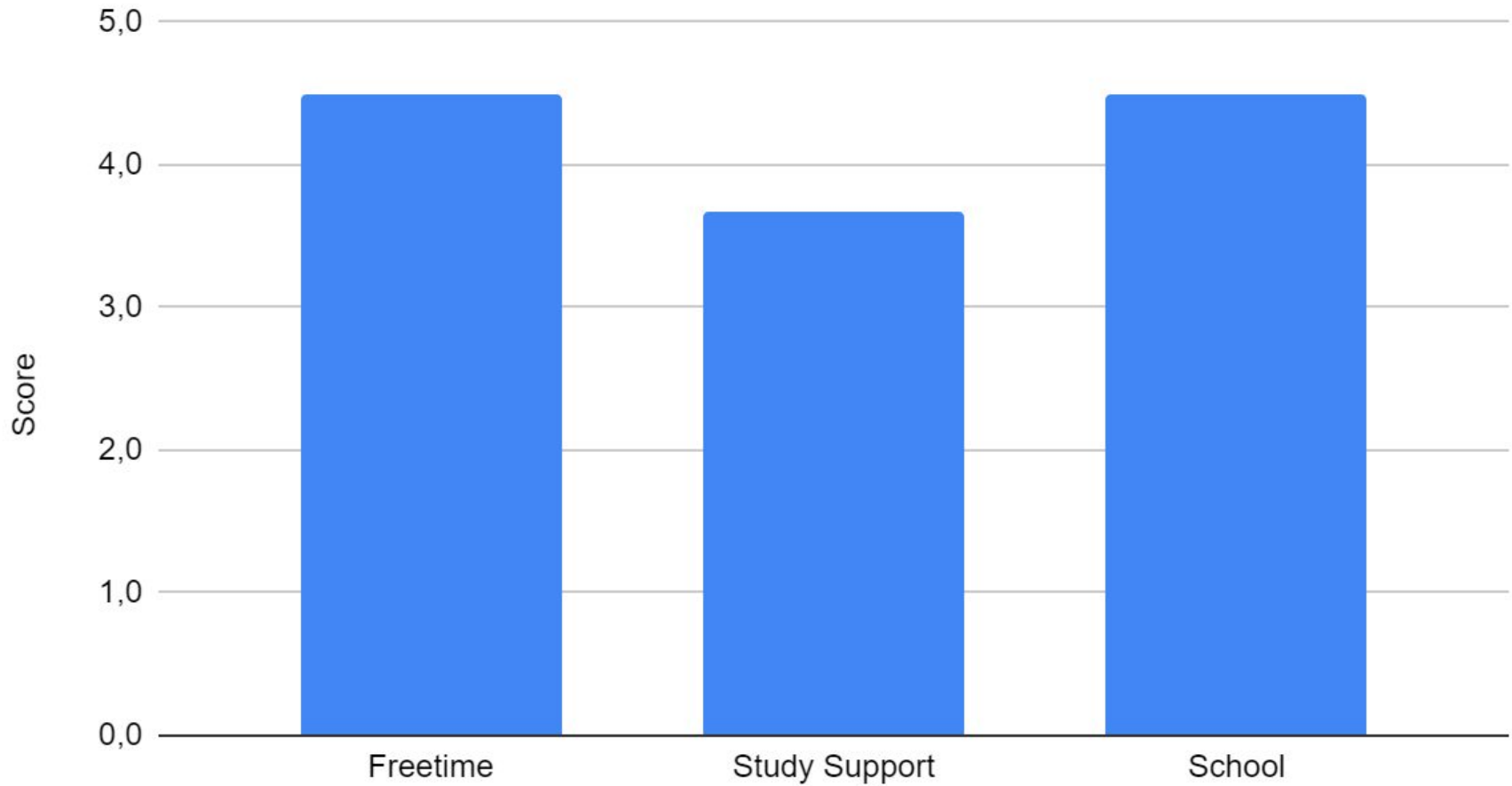
# Bonus: Tutorial

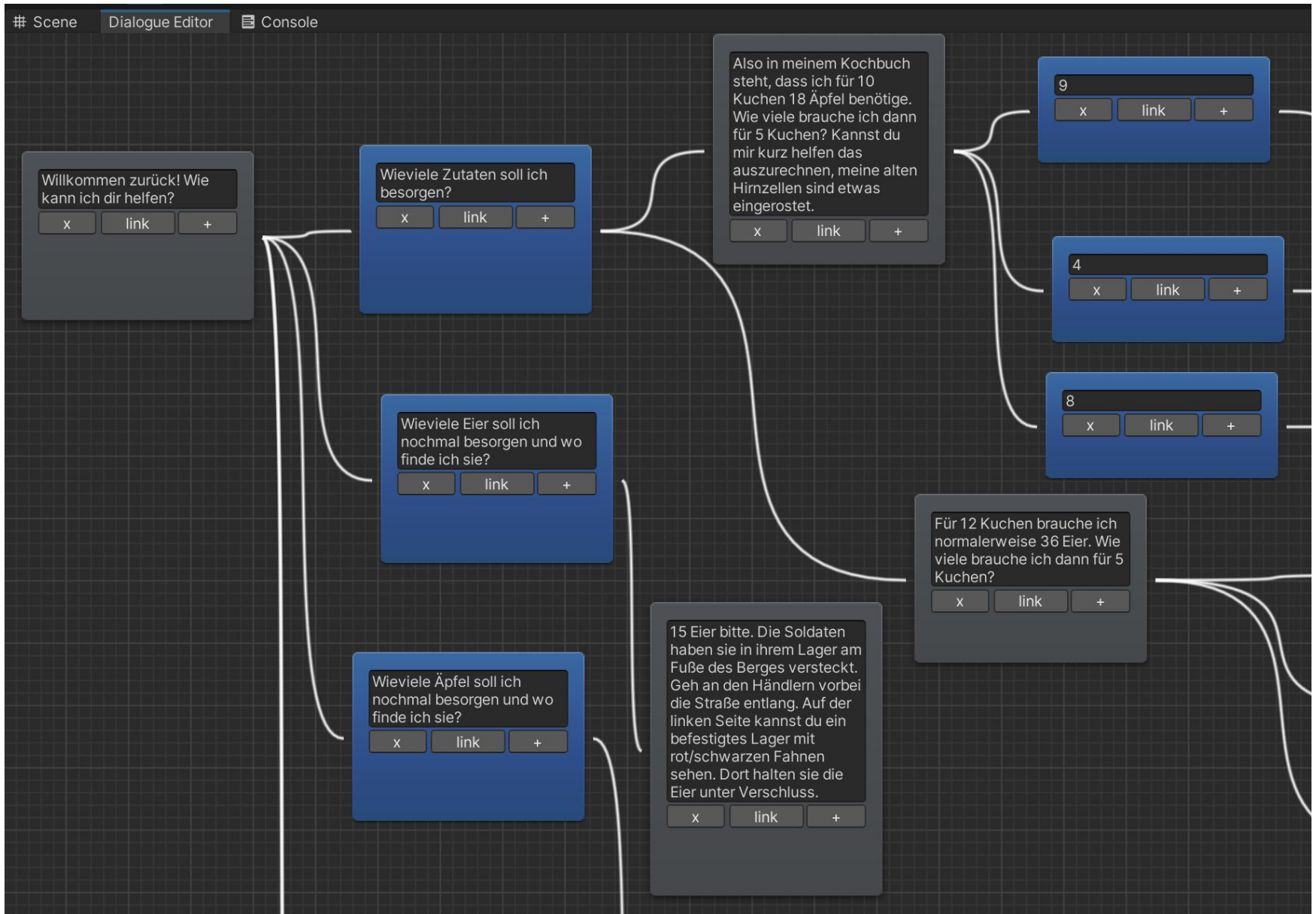


# What participants would do with the game



# Application Fields





# Bonus: Gameplay & Progression

- **Core gameplay**
  - Explore, open chests, complete quests, upgrade items
  - Get stronger
  - Fight enemies
  - Fun part: fast-paced combat
  - Serious part: slow-paced exploration, optimization, ...

# Bonus: Gameplay & Progression

- Core gameplay
  - Explore, open chests, complete quests, upgrade items
  - Get stronger
  - Fight enemies
  - Fun part: fast-paced combat
  - Serious part: slow-paced exploration, optimization, ...
- **Progression**
  - XP from enemies, quests -> level up
  - Increase stats, traits -> get stronger
  - Collect better items & upgrade Items
  - Difficulty increases
  - Story

# Bonus: Design Decisions

- **Game Design**
  - Familiar game mechanics
  - Hero and narrative through quests/dialogues
  - Support different playstyles
  - Tutorial
  - Fantasy theme, artstyle, clear goals, challenges, performance



# Bonus: Design Decisions

- Game design
  - Familiar game mechanics (Action RPG)
  - Hero and narrative through quests/dialogues
  - Support different playstyles
  - Tutorial
  - Fantasy theme, artstyle, clear goals, challenges, performance
- **Serious Content**
  - Focus on fun
  - Math voluntary
  - No Math in combat
  - Switch between slow-paced and fast-paced content
  - Feedback