Gamification of Machine Learning education in high school

Exploring Gamification to enthuse Young Students

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1 Introduction

ML education is gaining importance as ML becomes more integrated into our daily lives at an **increasingly younger** age with advanced social media algorithms and services like ChatGPT[1, 3]. This paper will examine the the effectiveness of general teaching methods applied to ML and zoom in on applying **gamification** to improve **motivation** in high school students.

To what extent does gamification as a teaching method work to improve the motivation among high school students for machine learning topics?

- To what extent do other teaching methods from general education translate to machine learning education?
- To what extent does gamification work as a teaching method in general education and what are its limitations?

2 Previous Work

Teaching methods like problem-based learning and hands-on learning from general education also **increase motivation** and academic performance in ML education [3]. Gamification, particularly with puzzle and strategy games, are promising in other educational fields, but **research lacks** in ML education [5]. One previous attempt at gamifying ML education noted some **pitfalls** that the game from this study will have to avoid [4].

3 Method

Based on literature, the experiment will focus on increasing motivation. The devised experiment consists of a **QCM** to assess motivation towards ML prior to playing the game [2]. Then the participants will play the **developed game**, followed by a final QCM.

The Experiment

- Entry questionnaire on motivation
- Playing the self driving car game
- Exit questionnaire on motivation

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3.1 The Game

The goal of the game is to train an **ML model to drive a car** along an infinite road while avoiding obstacles. The game consists of multiple levels, where new parameters are unlocked at each level.

The Levels

- Control car with arrows to get a feel
- Unlock parameters like sensor count and mutation percentage
- Everything unlocked, allowing successful training

Each level begins with a clear explanation of the **unlocked parameters** and the goal of the level. Players can move on to the next level at will.

The Game

- The car (blue) driving along
- Traffic (black) as obstacles to avoid
- Distance sensors (yellow) as input to model

4 Results

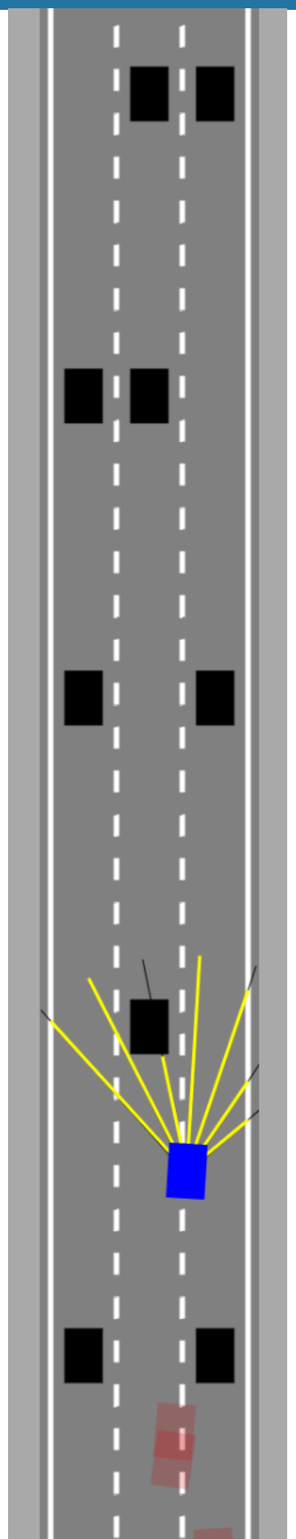
Results split into factors as per the QCM. Results show **increased motivation** and **decreased anxiety** in all participants (n=3).

QCM Results

Factor	Before Playing Game	After Playing Game
Anxiety	Low	Very Low
Challenge	High	Moderate
Interest	Moderate	High
PoS	High	High

5 Discussion and Conclusions

Voluntary experiment participation likely resulted in participants with above average prior interest in ML which could skew the results. The **small sample size** means we cannot draw definitive conclusions, but preliminary results suggest a **positive influence** of gamification on motivation in ML education.
All **participants enjoyed the game** and continued playing after the experiment had concluded. This suggests the game managed to avoid the pitfalls from previous work.



Abbreviations

ML	Machine Learning
PoS	Probability of Success
QCM	Questionnaire of Current Motivation

References

[1] *ChatGPT*. https://openai.com/chatgpt. Accessed: 08-05-2024.

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[3] R. Martins and C. Gresse von Wangenheim. "Findings on Teaching Machine Learning in High School: A Ten - Year Systematic Literature Review". In: *Informatics in Education* 22 (Sept. 2022).

[4] J. Parker and K. Becker. "ViPER : Game That Teaches Machine Learning Concepts - A Postmortem". In: Oct. 2014.

[5] Z. Zhan, L. He, Y. Tong, X. Liang, S. Guo, and X. Lan. "The effectiveness of gamification in programming education: Evidence from a meta-analysis". In: *Computers and Education: Artificial Intelligence* 3 (2022), p. 100096.

Play the game

jalmarvdh.github.io/RP-Game2