Unicorn Land
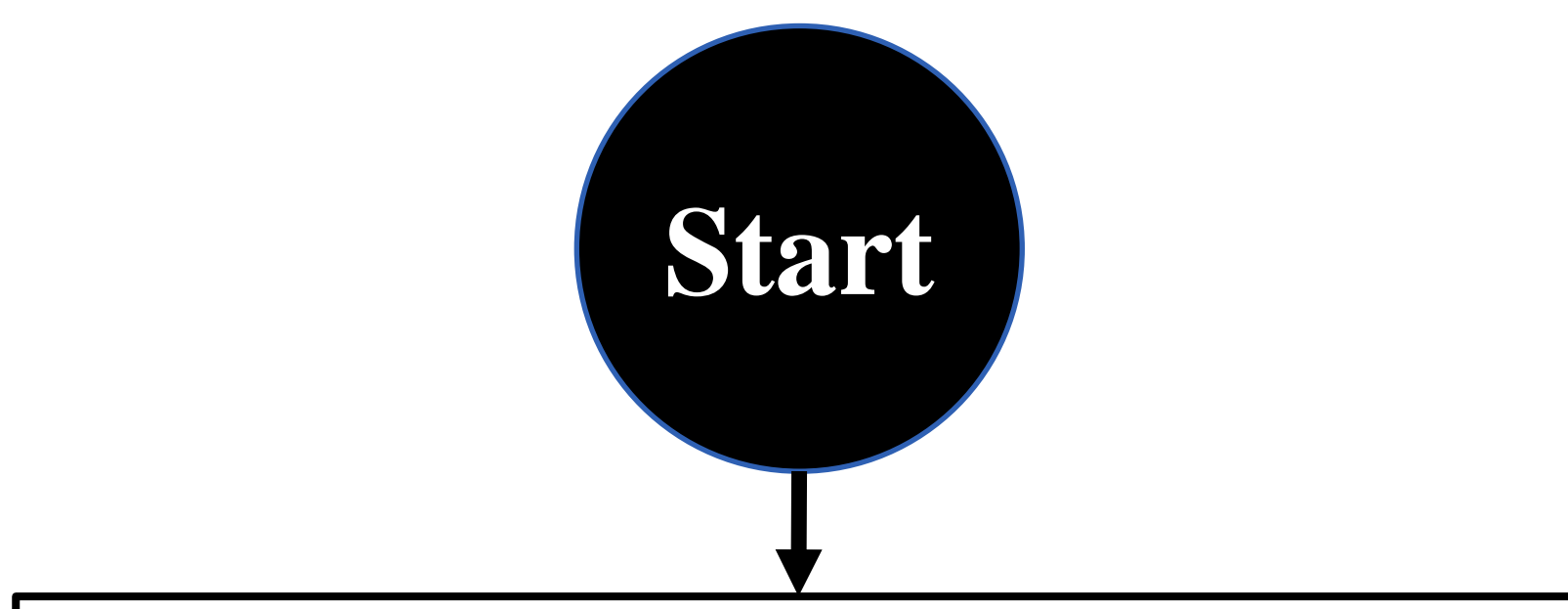
Teaching Using a Serious Game to Promote Student Engagement and an Equitable Learning Environment for Neurodiverse Students

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Start

Background and Motivation

- Observed students who exhibit common characteristics of students who are neurodiverse
  - Difficulty focusing
  - Lack engagement
  - Uninterested
  - Do not learn best from a traditional classroom
- Observations supported by research
  - The percent of college students with ADHD has increased over 500% in the past 20 years
  - The percent of students with autism has increased by nearly 700%

Research Question

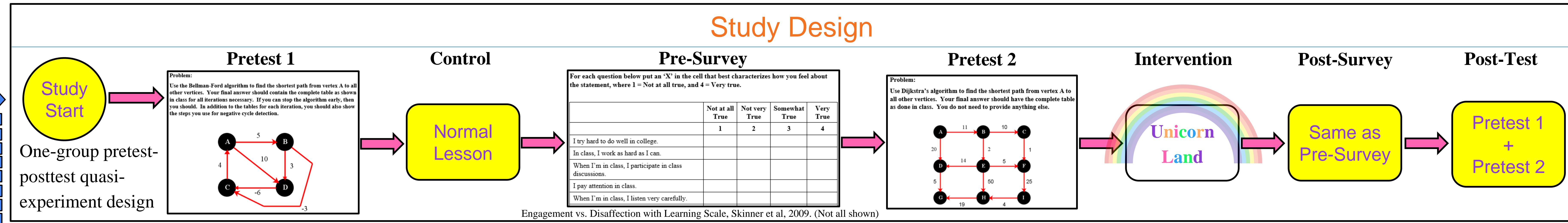How does teaching a lesson with a serious game effect student engagement and performance?

Serious Games

- A *serious game* is a game where the purpose of the game is not to win but to learn a concept or acquire a skill
- Serious games have been shown to
  - Increase equitableness in learning
  - Increase self-efficacy
  - Practice communication skills
  - Increase Motivation
  - Improve performance
  - Improve engagement
  - Provide equal opportunity to engage

Participants

- **Total Students:** 34
- **University:** UW-Platteville
- **Semester + Year:** Fall 2022
- **Course:** CS 3010 Algorithms
  - A required upper-level course taken by Computer Science and Software Engineering majors.

Study Design

One-group pretest-posttest quasi-experiment design

Study Start → **Pretest 1** → **Control** (Normal Lesson) → **Pre-Survey** → **Pretest 2** → **Intervention** (Unicorn Land) → **Post-Survey** (Same as Pre-Survey) → **Post-Test** (Pretest 1 + Pretest 2)

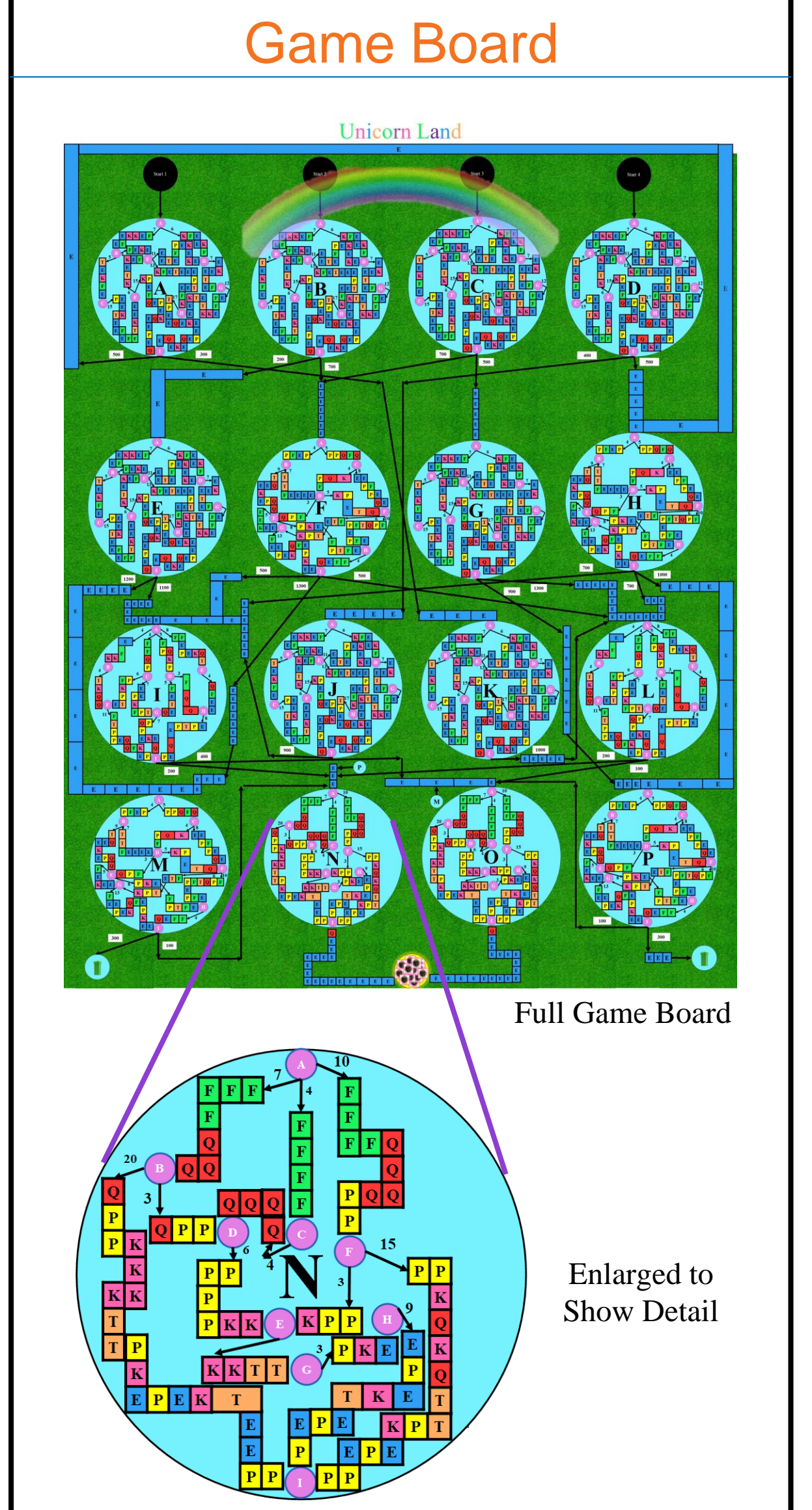Engagement vs. Disaffection with Learning Scale, Skinner et al, 2009. (Not all shown)

The Game

- Unicorn Land is a unicorn-themed Mario Kart-style board racing game.
- The objective of Unicorn Land is to use Dijkstra's algorithm to find the shortest path down the Unicorn River and be the first unicorn racer to reach the treasure of Kiwi Koins.
- Players take turns rolling a die to race down the Unicorn River.
- Players answer questions about Dijkstra's algorithm to gain Kiwi Koins
- Players may obtain Mario-Kart themed Power-Ups to gain an advantage and use Kiwi Koins to enhance the power-ups

Game Board

Full Game Board

Enlarged to Show Detail

Space Types

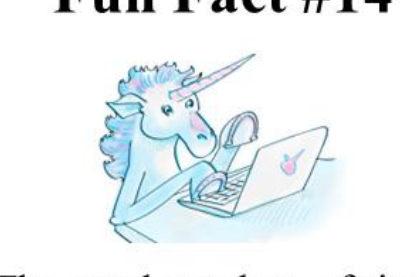| Space Type	Space	Description
Vertex	A	Vertices are safe squares from Power-Up attacks.
Empty	E	An empty square is where no additional action occurs.
Fact	F	Any player who lands on a fact square will draw the next fact card. This is available for all players.
Question	Q	Any player who lands on a question square will draw the next question card. All players can answer the question. Players who answer a question correctly gain 1 Kiwi Koin.
Power-Up	P	Any player who lands on a power-up square will draw a power-up card. Kiwi Koins can be used to level up the power-up card for a more powerful effect.
Kiwi Koin	K	Any player who lands on a Kiwi Koin square will gain 1 Kiwi Koin.
Teleport	T	Any player who lands on a teleport square will roll a die and teleport to the location based on the die roll.

Fact, Question, Answer, and Powerup Cards

Fun Fact #14

The total number of times elements are updated is equal to the number of edges (E)

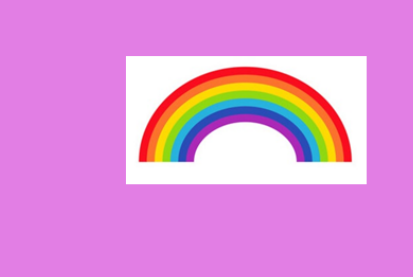**Question #14**

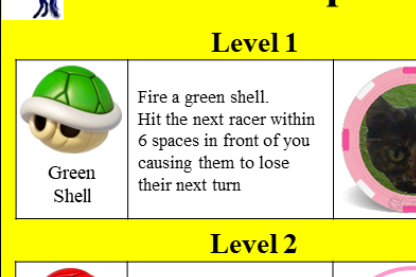What is the time complexity of Dijkstra's algorithm?

Answer #14

$O(E\log(V) + V\log(V)) = O((E+V)\log(V))$

The extraction is done V times with log(V) complexity for each extraction. The updating is done E times with log(V) complexity. Adding both of those together results in $O((E+V)\log(V))$

Power-Up

Level 1 — Green Shell — Fire a green shell: Hit the next racer within 4 spaces in front of you, causing them to lose their next turn.

Level 2 — Red Shell — Fire a red shell: Hit the next racer within 12 spaces in front of you, causing them to lose their next turn. — Insert 1 Kiwi Koin

Level 3 — Magic Crush Shell — Fire a magic crush shell: Hit all racers in front of you in the mini-map, causing them to lose their next turn. — Insert 2 Kiwi Koins

SoTL Project Timeline

Fall 2021	Spring 2021	Summer 2021	Fall 2022	Spring 2022
Observation	Idea	Research	Implementation	Results

- Observed lack of engagement in class
- Became aware of increasing neurodivergent student population

- Developed the initial idea
- Performed scholarly research on research topic

- Attended Summer Institute
- Refined research questions and methodology with help from WTFS participants
- Time commitment to WTFS made this possible

- Created the game
- Unicorn-themed based on the instructor's persona
- Racing type influenced by the lesson content
- Conducted the SoTL study

- Analyzed experiment data
- Report results at OPID 2023

Reflection

Analysis and Results

Engagement

Post-Survey - Presurvey Differences
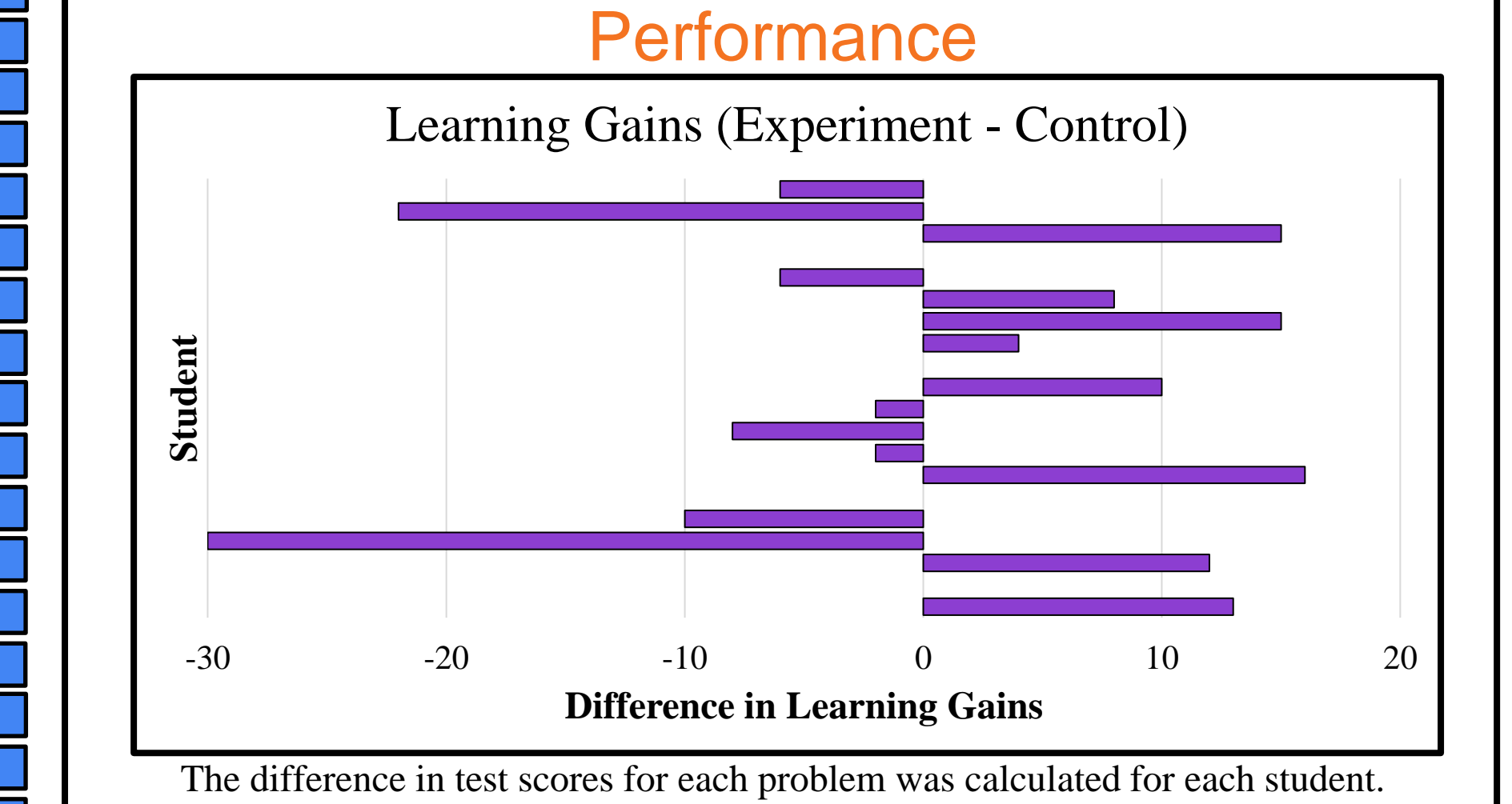

Survey responses were converted to a numeric value of 1-4. The average value for each student was calculated and the difference between pre and post surveys were calculated.

Performance

Learning Gains (Experiment - Control)

The difference in test scores for each problem was calculated for each student.

Result Summary

	Control	Experiment
Engagement (Range = 1-4)	3.18	3.16
Performance Gains (Max = 50)	+44	+43

Reflection

What makes this equity-minded SoTL?
- Provides an equal opportunity to engage in class
- Provides a more equitable learning environment for students who are neurodiverse

What influenced this project?
- This project was influenced by my own observations in class, student feedback, and existing SoTL research

What did students think?
- Fun, engaging, and effective for learning
- A smaller game board would improve the game tempo

Future Work

- Conduct a more formal study with two course sections (one as a control group)
- Research on good instructional tutorials such that the lesson can be completely self-taught without instructor intervention

Conclusions

- No statistically significant differences in engagement or performance
- Game and survey can be improved for a better experience and accurate results

Acknowledgements
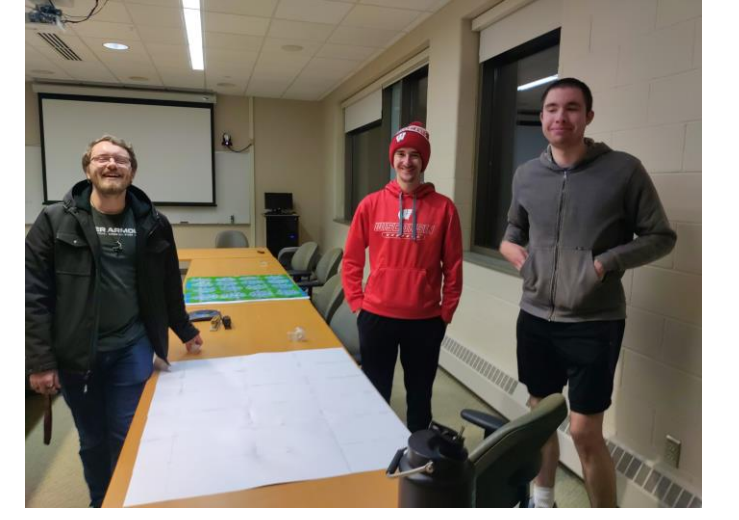
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