Experiential Learning in Game Theory: Project AXLRD

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Introduction

Simulations and games are valuable pedagogical tools for engaging students in experiential learning. However, how can we conduct these kinds of experiences in complex environments without compromising either the setting or the learning goals?
- We present a set of tools (software + teaching) which can be used to build and play complex simulations in an accessible and engaging way.

Educational Context

- *Students*: 1st - 4th year, non-technical, general background (no required math or CPSC background); economics, computer science.
- *Classroom*: large (100+) classroom, 1 hour sessions, minimal TA support

- *Learning objectives*: applied game theory and programmatic reasoning; to understand how beliefs can create emergent complexity and cooperative behavior, and how strategic thinking works
- *Experience*: based on Axelrod (1980)'s repeated Prisoner's Dilemma tournament

Key Challenge

- Experiential learning theory (Kolb, 1980) requires <u>active experimentation</u>
  - Requires on-going interaction with learning context
- Learning context requires (a) complex setting (can't simplify) and (b) experimentation (but no specific skills assumed)
  - Simulation "too complex": learning to "play" the game instead of understanding context

Motivating Question

- How do we let students actively experiment in the game theory without programming skills or tools?

TLEF: Project AXLRD

- Web-based educational application based on Blockly framework allows for user-friendly design and playing of simulations
  - No technical skills necessary
  - Intuitive, easy to use

Fig 1: AXLRD Strategy Builder Tool

Interactive interfaces uses "snap-together" framework to build working code which can be run to perform simulation
Generated strategies can be run and completed – with feedback
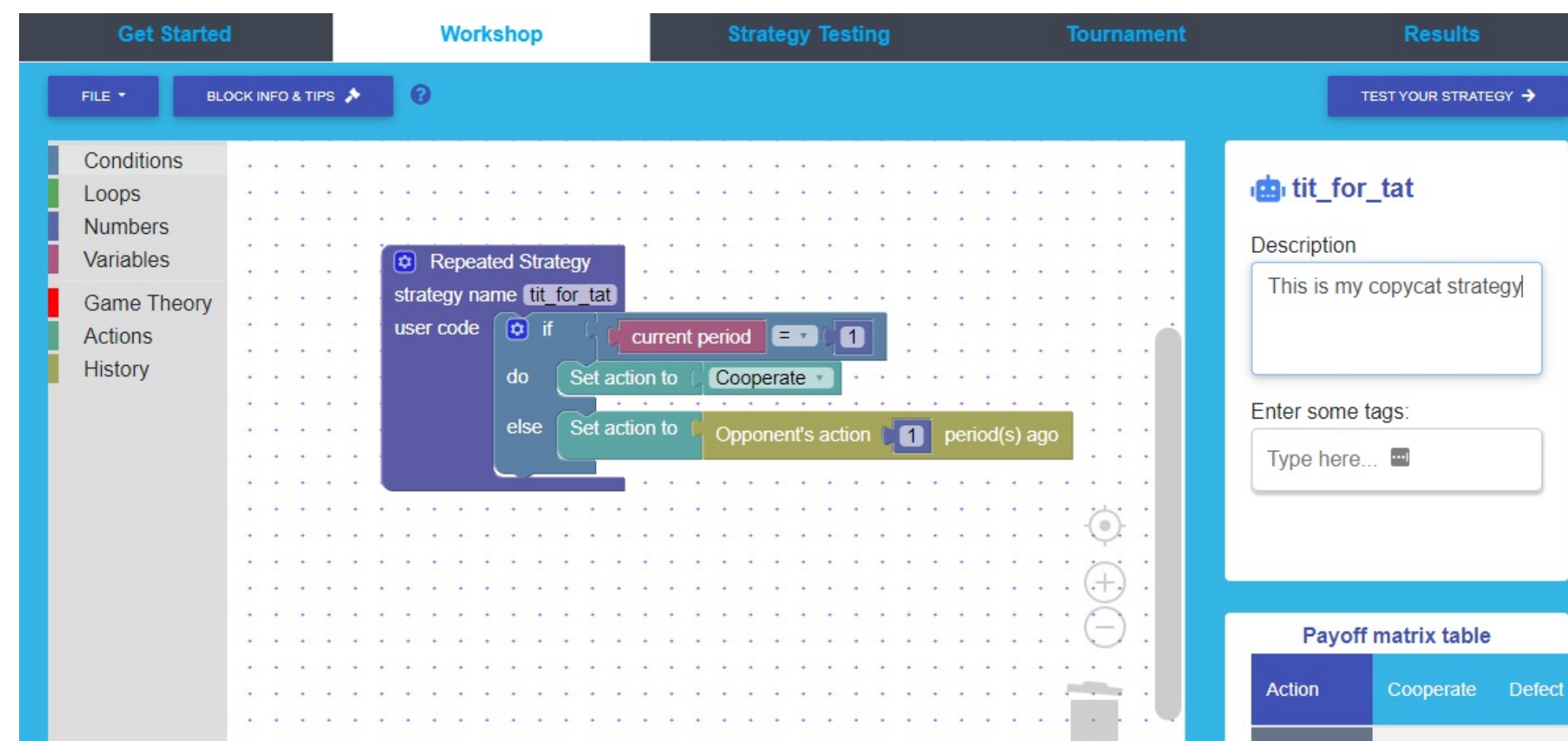
- AXLRD uses a "snap-together" user interface which allows students with no programming experience to develop complex interactive strategies,
- Students can experiment and play against other students in a re-creation of Axelrod's repeated games tournament.

- Supported with a series of teaching and learning aides to support instructors using the Project AXLRD tool, including (i) lesson plans, (ii) lecture slides, and (iii) assessments.:

Development Process

- Two-year development timeline, mainly using student (co-op) developers
- Integrated and support from CTLT and IT
- Development was easier than original estimates (even given COVID-19 problems)

Evaluation and Feedback

- Evaluated (and guided development) using a series of student feedback surveys
- Supplemented with user trials and workshops

Fig 2: Student Feedback Results

Evaluated based on post-class feedback give acknowledgement to the original source of the material.
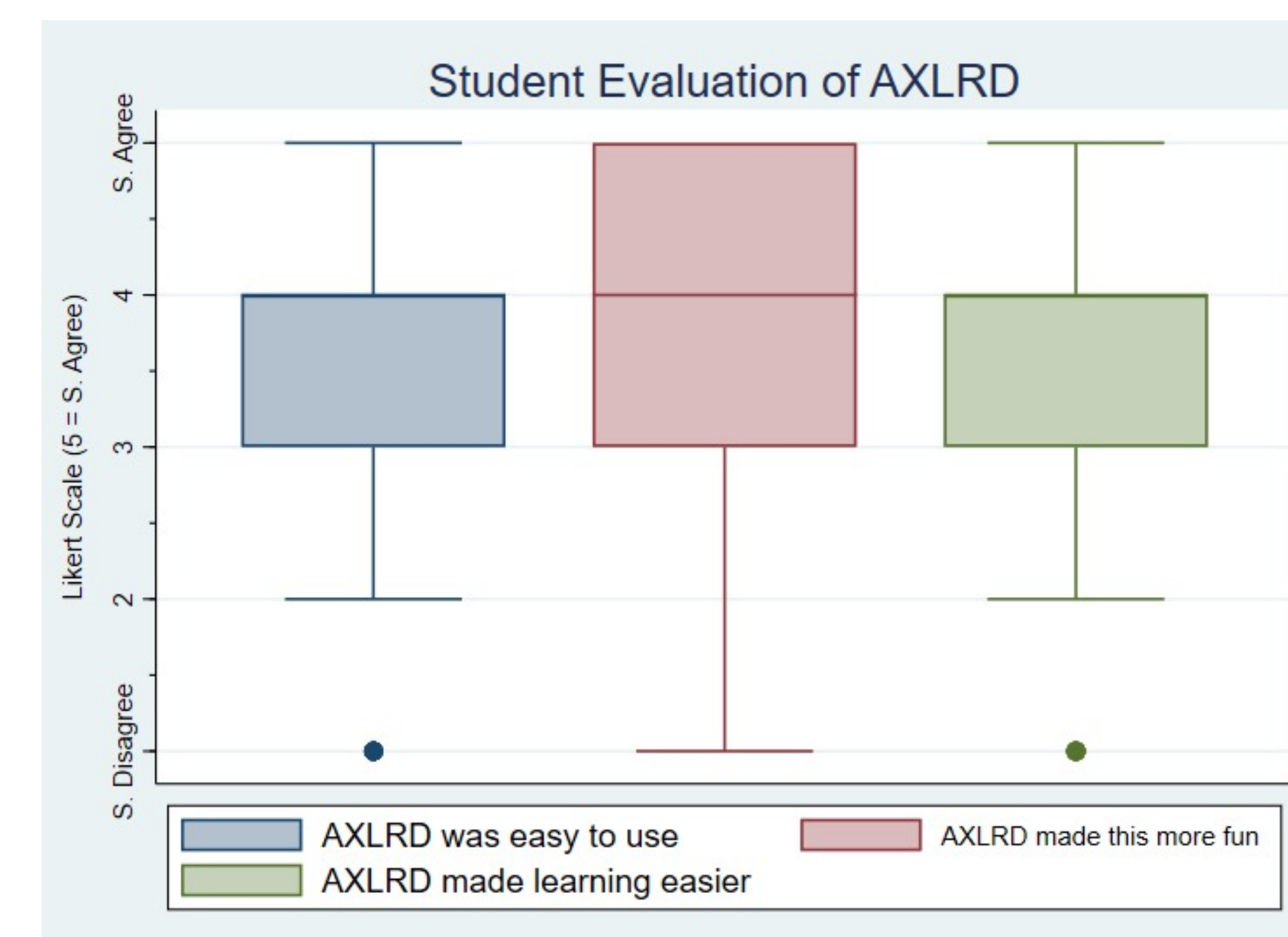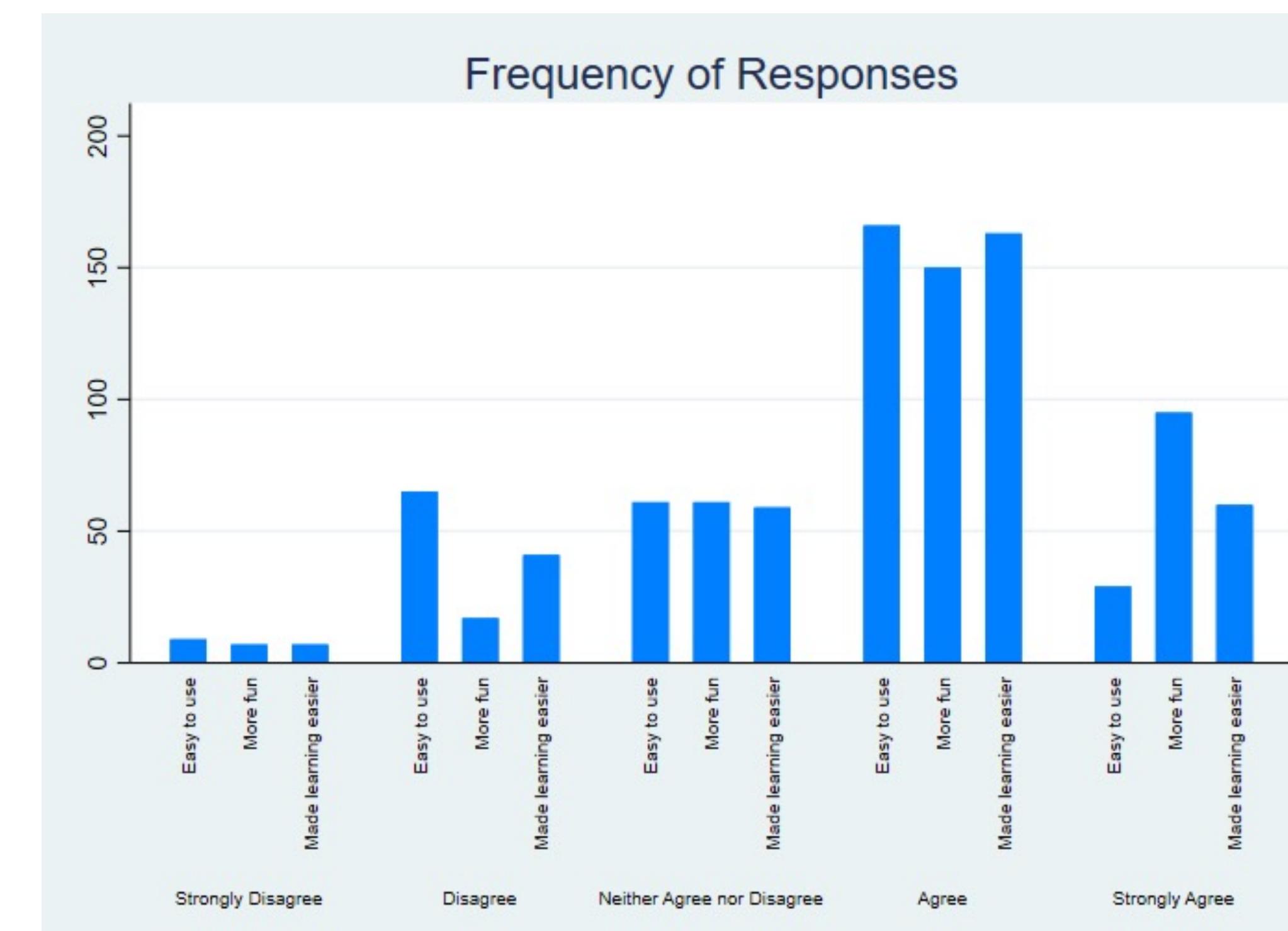
Outcomes

Student evaluation of project was very positive:
- 74% agreed it made learning more fun
- 67% agreed that it made learning easier
- Biggest challenge was in ease-of-use: there was key indication that good training was key

Faculty involved also found several benefits:
- Increase introduction to strategic thinking and experiential learning in non-traditional settings.
- Clear and tangible benefits to peer-learning and group interaction in this environment
- Interesting and unexpected sophisticated in student strategies and behavior was observed
- Learned that Blockly and this tool-kit is more flexible and easier to use than expected, with many potential uses in other courses

Conclusions

This project demonstrate a practical, scalable and effective way to encourage experiential learning in courses that involve strategic thinking and analytical reasoning, with potential applications in other areas

Reference / Bibliography

1. Axelrod, Robert. 1980. "More Effective Choice in the Prisoner's Dilemma." Journal of Conflict Resolution 24 (3): 379–403.
2. Kolb, David A., Richard E. Boyatzis, and Charalampos Mainemelis. "Experiential learning theory: Previous research and new directions." Perspectives on thinking, learning, and cognitive styles 1.8 (2001):

Acknowledgements