Investigating Student Learning about Disease Spread and Prevention in the Context of Agent-Based Computational Modeling

This work was supported by NSF 1842375

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01 Introduction

Background

COVID-19 has brought increased attention to the importance of health literacy, including the understanding of the transmission and prevention of disease.

Problem

Researchers have found that computational models could support the teaching and learning of topics in epidemiology. Their study was limited to undergraduate and graduate students and there is therefore a need to study how adolescents learn about epidemiological topics through computational modeling.

02 Context

This study presents data from a project aimed at developing a computational modeling microworld to help middle school students learn about the spread of disease. The microworld is meant to help students model and test their ideas about how a disease spreads through a population and how an epidemic can be prevented. The present work investigates the question:

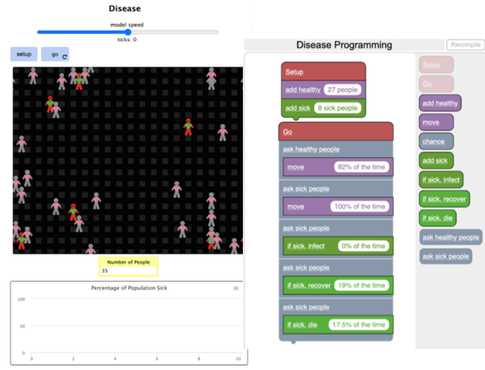
"How does the computational block-based modeling microworld help students move from their initial thinking to their later thinking, with respect to disease prevention strategies?"

03 Methodology

We employed a lab-based case study approach (Yin, 1998). We conducted a one-on-one 1.5-hour interview through Zoom with a 12-year-old student we call Max. During the interview, Max was asked questions about the spread and prevention of disease and then invited to model and test his ideas in the microworld.

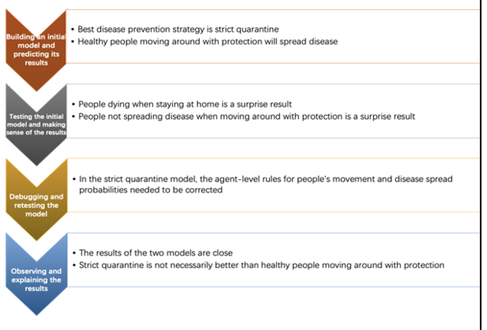
04 Modeling Microwrold

students interact with a NetTango microworld. Instead of writing text-based programs, students use blocks to build and test models and examine how patterns emerge from simple rules and interactions at the system level. In this study, students built and tested a model representing the spread of disease and its prevention to explore how the individual-level interactions could give rise to a pandemic, and how the individual's different protection behaviors could make an impact on the overall health of the public.



05 Analysis

We audio-recorded and transcribed Max's interview. We conducted a microgenetic analysis (diSessa, Sherin, & Levin, 2016) to produce a temporal decomposition of Max's thinking trajectory with respect to disease prevention and protection strategies. First, we reviewed the recording of Max using the modeling microworld to build models of two different disease prevention strategies. We noted times during which he built, tested, debugged, and made sense of his models. These episodes were marked on the transcript, which was then analyzed to understand his process of knowledge refinement.



06 Findings

Computational modeling can help students refine their thinking regarding **disease protection** through building models and predicting results, testing models and making sense of the results, debugging and retesting the models, observing models, and explaining results.

07 Takeaways

•The paper analyzes one student's **knowledge refinement through the building, testing, and debugging of a disease spread and prevention model.** We model student refinement of thinking through steps of building initial models and predicting results, testing initial models and making sense of the results, debugging and retesting models, observing final models, and explaining results.

•Potential Contribution to the learning sciences: findings suggest **adolescents can learn about strategies for disease prevention through computational modeling**.

•**Computational modeling** is an important topic in the learning sciences - more specifically, the use of microworlds for learning. Using this platform allows students to explore **mechanisms of disease spread and prevention**, both topics of critical importance today.

Learning Dynamics Lab

https://cehs.usu.edu/itls/projects/ldl/index

Related Literature

Wilensky, U., & Reisman, K. (2006). Thinking like a wolf, a sheep, or a firefly: Learning biology through constructing and testing computational theories—An embodied modeling approach. Cognition and Instruction, 24(2), 171–209

Wilkerson-Jerde, M. H., Gravel, B. E., & Macrander, C. A. (2015). Exploring shifts in middle school learners' modeling activity while generating drawings, animations, and computational simulations of molecular diffusion. Journal of Science Education and Technology, 24(2–3), 396–415.