COMPUTATIONAL MODELING INTERVENTION: USING DYNAMICAL MODELS TO TEACH COMPLEX BIOLOGICAL PROCESSES

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Introduction
This study utilizes the interactive modeling program, Cell Collective, to simulate biochemical and biological pathways typically seen in college-level science courses. These models offer an alternative method for students trying to grasp complicated biological pathways. Rather than memorizing static, 2-dimensional diagrams from textbooks and lecture slides, students are able to visualize the interconnectedness of pathways by constructing, simulating and interacting directly with them. The goal for these models is to make the molecular mechanisms presented in class easier for students to comprehend by adding an interactive and dynamic aspect to learning.

Available Courses
Cell Collective offers a wide array of published, highly comprehensive models that can be implemented in introductory biology, immunology, and cancer biology courses (Figure 2).

Research Objectives
The purpose of this research is to determine how our computational modeling intervention (CMI) can be implemented in the classroom to engage students and effectively help students understand complex biological processes. In order to determine this, we need to ask the following:

• Does the CMI impact classroom assessment results?
• Is the CMI practical/accessible for students without a computer science background?
• What aspects of the CMI are better teaching tools than traditional teaching methods?

Further, this study will investigate how to accurately measure the difference in teaching effectiveness between the CMI and traditional methods. This will require cross-examining personal experience surveys with assessment results. How to compare these two aspects is a vital step in analyzing the data and drawing conclusions as to the effectiveness of computational modeling with Cell Collective in a classroom setting.

Figure 2. Models Available Through Cell Collective

Preliminary Data
During the Spring semester of 2016, the Positive and Negative Feedback Loops module (Figure 3), was piloted in a classroom setting. Students gave the following feedback:

• Students found the module enjoyable
• Students believed they had a better understanding of positive and negative feedback loops after completing this module
• Module was lengthy

Figure 3. Positive and Negative Feedback Loops Module: A. MAPK Pathway; B. Simulation of MAPK in Cell Collective

Future Endeavors
• Finalization grading rubric for better data analysis.
• Pilot Cell Cycle Regulation module.
• Finalize Positive and Negative Feedback Loops module for implementation in LIFE 120 classes.
• Add more models and learning modules to Cell Collective.
• Create new and engaging ways for students to interact with Cell Collective models.

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