SimSnap: Orchestrating Collaborative Learning in Biology through Reconfigurable Simulations

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Goals of the SimSnap Project

The vision of this project is to develop innovative reconfigurable simulations and a teacher's orchestration dashboard to support open-ended student-driven science learning along all three social planes: individual, small group collaboration and whole class. Our major goals are to develop:

- A technical framework for connecting tablets together to create shared collaborative simulations, to help students seamlessly move between individual, small group, and whole class configurations, to collaboratively construct knowledge;
- Design-based curricula to support students' understanding of connections between science ideas;
- New approaches for supporting teacher's classroom orchestration and facilitation

Context: SimSnap Community Garden Design Challenge

Curriculum Goals

- Addresses NGSS core ideas, science practices, and crosscutting concepts for middle school life sciences with a focus on plant biology, ecosystems, and genetics;
- Immerses student in **authentic bio-engineering design** challenge to construct a community garden that produces a lot of food, while minimizing negative impacts to the environment;
- Students plan and conduct iterative simulation investigations to create and explain their community garden designs based on underlying science ideas as well as evidence from their investigations

Digital Science Notebook

Purpose and description of facets
Support for Students' Science Learning

- Prompts for design and scientific reasoning and knowledge construction
- Automated integration of experiment data from SimSnap simulations
- Provide platform for orchestration of individual, group, and whole class ideas

Support for Teacher Scaffolding

- Monitor students' learning through unit
- Track iterative design history of student experiments
- Create aggregated summaries to show a map of common and/or persistent (mis)understandings
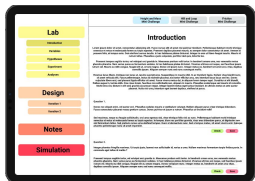
Support for Management

- Deliver notifications to the classroom, groups, or individual students
- Export data needed to answer research questions
- Select varying types and levels of logging

Example Prompts to Support Students' Reasoning

- *Which experiments support your claim?*
- *How do you know that when the temperature is higher, plants need more water?*

Reconfigurable Simulations

- Interactive community garden simulation
- Support collaborative simulation modes based on spatial configuration of student devices
- Collaborative modes provide granular simulation control
- Enable students to nurture immersive plant ecosystem in small groups
- View data from other groups and previous simulations

Teacher Orchestration Tools

Supporting the teacher as a wandering facilitator, during student-driven inquiry

- Grouping of students based on teacher or system driven decisions
- Leverage student interactions with the notebook, simulation, and student speech data to alert the teacher of the state of the class at the individual, small group, and whole class levels
  - Unproductive or productive states
  - Role taking
  - Uptake of key concepts
- Alert teacher to key points in students' inquiry for review and discussion

Collective Knowledge Generation Tool

- Real-time note tool to allow individual students or small groups to generate ideas and promote them to a shared display for class discussion and synthesis
- Tool to develop lines of inquiry, affinity groups, and new avenues for discussion
- Customizable scaffolds and prompts based on groups or past work.

Plans for Data Collection and Analysis in Y2

Pilot Study - Summer 2021

- Understand children's interactions with the simulation
- Test out notebook and collective knowledge generation tool
- Pilot real-time voice capture and analysis
- Test out early EDM/LA approaches for notebook and speech (NLP etc.)

First Implementation - Spring 2022

- Work with one classroom to implement SimSnap curriculum
- Examine student reasoning in notebook
- Student concept maps to understand their learning about connected science concepts
- SNA of speech and notebooks to understand diffusion of ideas in a learning community
- Examination of students' explorations in the simulation to reveal their thinking on biotic and abiotic factors for plant growth
- Video analysis of teacher interactions with students to refine orchestrational supports