Science Classroom Inquiry (SCI) Simulations for Generating Group-Level Learner Profiles

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Abstract: Our previous work demonstrated that Science Classroom Inquiry (SCI) simulations effectively teach content knowledge and authentic science practices. Here we demonstrate that SCI simulations, with their non-linear authentic structure, allow for investigation of the unique inquiry-driven paths generated by students. These paths can be used in conjunction with other metrics to construct learner profiles. These learner profiles provide insight into the cognitive processes students use as they participate in simulated authentic science inquiry.

Keywords: science education, simulations, problem based learning, learner profiles

Introduction

Recent science education calls in the United States have resulted in *Next Generation Science Standards* emphasizing the importance of teaching students science practices, disciplinary core knowledge, and crosscutting concepts (Achieve, Inc 2013, NRC, 2012). Allowing students an opportunity to engage in science inquiry that is grounded in real-world problems *and* that allows authentic, non-linear investigation is expected to foster students' collaborative learning. Simulating such inquiries via computer-based simulations removes many of the typical time and instructional barriers (NRC, 2011, Renken, Peffer, Otrel-Cass, Girault & Chiocarriello, In Prep). Our previous work (Peffer et al, In press), demonstrated that Science Classroom Inquiry (SCI) simulations were effective at presenting an authentic-inquiry experience to students that resulted in student-reported learning gains and alterations in perceptions of authentic science practices. To better understand actual student outcomes when given investigative flexibility, we set out to identify the presence of unique inquiry-driven pathways generated as students worked through a SCI simulation. Preliminary data collection with groups of middle school students indicated that each student group generated its own unique hypothesis and pursued unique testing strategies—generating group-specific pathways. Here we discuss relations between group pathways, initial hypotheses, and conclusions. We also highlight implications for research, design, and instruction.

Methods

Participants

Participants were recruited from students involved in an extracurricular educational activity at a zoo located within a large mid-Atlantic city. Students were first introduced to background information pertinent to completing the simulation and then completed the *Unusual Mortality Events* SCI simulation. The participants included both males and females of mixed ethnicities in grades 6-8.

Design and procedure

Students worked in groups of 2-3 to generate a hypothesis, utilize a testing strategy and make final conclusions. As student groups completed the simulation, the simulation engine automatically recorded their entries and decisions. We analyzed the archived and de-identified data to determine the learner profiles generated by student groups.

Findings

Although all students were presented with the same background and problem, each group of students worked through the simulation in a slightly different manner (Figure 1). Each group's initial hypothesis is shown on the left hand side of the figure, and final conclusions on the right hand side. Black dots represent when a group decided to pursue a particular experiment. Each group's progress can be traced by following the black lines.

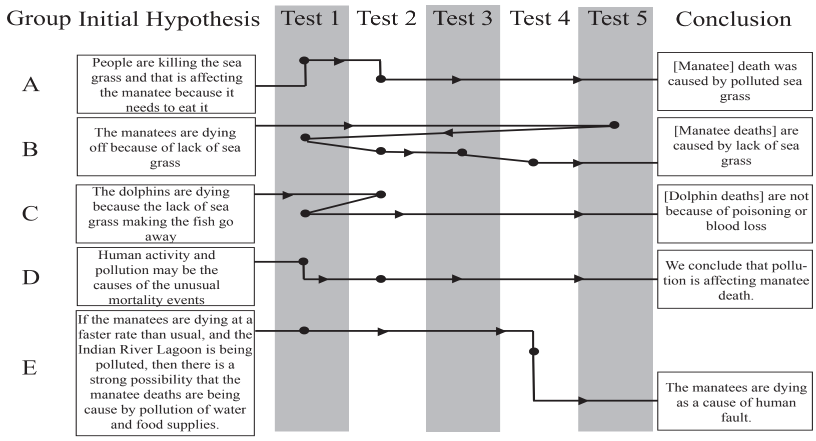

Figure 1. Student group pathways from the *Unusual Mortality Events* SCI simulation.

Conclusions and implications

New technologies, such as SCI simulations, have the potential to revolutionize science education not only by providing enriching, authentic experiences normally not feasible for typical classrooms, but by allowing for flexibility that leads to a more personalized learning experience. The data presented here on group pathways provides preliminary evidence that SCI simulations offer a powerful, real time view of group-level decision-making. Each group generated a distinct profile that contained unique hypotheses and conclusions, as well as the unique path through the simulation. To further delineate the role of collaboration, future work positioning students working in groups each with individual computers (rather than multiple students around a single computer) will allow better assessment of group- versus individual-level work. Analysis of virtual laboratory notebooks yielded insights into the students' decision-making, preferences, and barriers to hypothesis revision. Importantly, these data are obtained in real-time without disturbing the students during the inquiry task. Combinatorial analysis of learner inputs in response to various findings within the simulation and the groups' approaches to completing the simulated inquiry may yield increased insight into students' cognitive models of science practices (Chinn & Brewer, 2001). Understanding these cognitive models will lead to an improved understanding of how students evaluate data in a simulated authentic science inquiry experience. This is especially important given recent calls for a better understanding of the role of technologies, like simulations, in learning (NRC, 2011).

References

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