Formative Evaluation of Activity Structures for a Middle School Climate Change Curriculum

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Abstract: We report the results of formative evaluation of an interactive map and collaborative writing activity designed for middle-school students. An analysis of the data showed that many students had difficulties manipulating the data overlays that were an essential feature of the map activity. In addition, many students also appeared to misunderstand the intent behind the collaborative writing task. The findings have implications for the design and efficacy of CSCL-based curricular activities for middle school science.

Introduction and Background

In science education research, innovative curriculum development is often a substantial effort that spans years and requires the input of many individuals. In some cases, a project may require contributions from a team of specialists, including scientists, educational researchers and technology developers. Given the expenditure of effort and resources required for developing large-scale research-based curricula, it is important to assess the design and efficacy of activity structures while still in the formative stages of development.

Although it could be argued that most school-age children today have a fair amount of computer proficiency, few studies have specifically examined how children interact with educational technologies (Shapiro, 2008). More often than not, efforts to design computer-based learning environments have relied on developers' assumptions of how children engage with digital material (Nielsen, 2010). In education, formative evaluation is essential for structuring CSCL activities that support specific learning goals. Without it, researchers risk designing curricular materials that require students to adapt and adjust to the new technology environment, rather than designing the environment in a way that is sensitive and responsive to students' needs (Seo & Woo, 2010). By evaluating activities early in the process, researchers can capture valuable input that can inform or change subsequent design decisions (Poore-Pariseau, 2010). The goal of the current study was to identify potential problems with the structuring and design of two activity types: a beta version of a predicted distribution modeling (PDM) tool and a collaborative writing task.

Methods

Participants in the study included 84 middle school students from the United States and Canada. The mean age of the students was 11.57 (*SD* = 13.77). Data sources included an online questionnaire, students' responses to questions about a map activity, students' online edits to a peer-authored paragraph, and interviews.

Working with a software developer, we designed an interactive activity using Google maps that was a simplification of the kind of predictive distribution modeling that is central to our curriculum (Figure 1). The activity required students to click on a series of mock data overlays in order to answer questions about the map contents. Designing a usable interface was critical so students could focus their attention on understanding the meaning of the data layers, rather than focus their attention on how to go about manipulating them. Since the final activity will include overlay data that is significantly more complex (Figure 2), it was critical to learn about the difficulties students faced when interacting with this type of activity and data structuring.

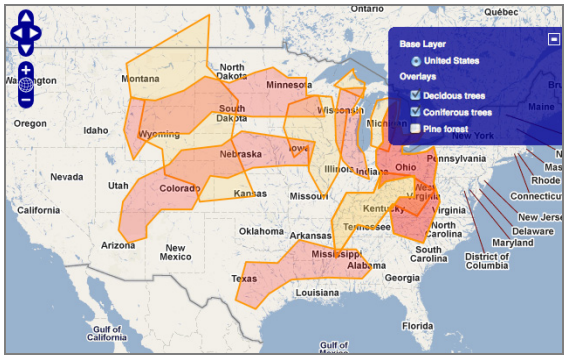

Figure 1. Mock Overlay Data for Evaluation Study.

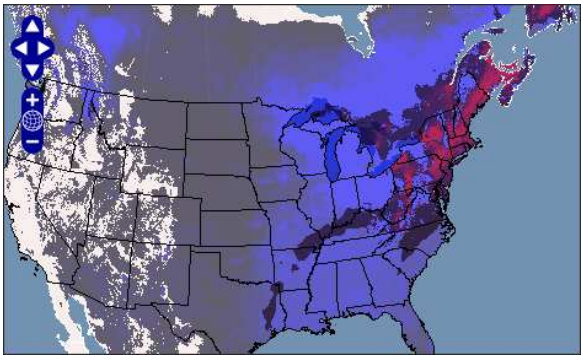

Figure 2. Authentic Overlay Data for PDM Tool.

Results and Discussion

The PDM map activity included four questions about the types of trees one could find in the United States. To

answer these questions correctly, students had to make use of colored data overlays to identify the distribution of tree types. For example, to answer the question "Can you find coniferous trees in Oregon?" students would first have to pan to the left to find the state of Oregon (all states were clearly labeled), and then resize the map with the zoom function to distinguish between state boundaries. Students would then have to click the tree data layers (deciduous, coniferous and pine forests) to determine which of those tree types could be found in the state of Oregon. A review of the responses revealed that many students answered the map questions incorrectly (Table 1). Given that all the questions were simple Yes/No questions with only one accurate response, it is probable that students had difficulties manipulating the map interface and data layers when answering questions about the tree distributions.

Table 1: Students' responses to questions about map data.

Question	Correct Response	Incorrect Response
1. Are there deciduous trees in Texas?	43%	57%
2. Are there pine forests in Arizona?	52%	48%
3. Can you find coniferous trees in Oregon?	64%	36%

In the collaborative writing activity (Figure 3), students were asked to watch a short YouTube video commercial and then expand on a paragraph about the commercial that was written by another student. A review of the data suggests that students had difficulties interpreting the purpose and intent behind this activity. Rather than extend the ideas of the existing paragraph, 38% of students made superficial edits and 26% simply appended the paragraph with an additional sentence. Other students (22%) left the paragraph unchanged, while others (14%) deleted the paragraph and wrote something different altogether. When asked in an interview why she chose not to make any changes, one student replied: "Well, I don't want to change what [the other student] thinks, they should be allowed to have their own opinion."

Figure 3. Collaborative Writing Activity Based on YouTube Video.

Conclusion

The findings from this study have implications not only for our own research project, but also for CSCL research more generally. With respect to usability, both the map and collaborative writing activity presented challenges that were inherent in the design and structuring of the activity. When using the mapping tool, many students had difficulties making the connection between the physical map overlays and the data they represented – a critical distinction for using maps to answer scientific questions. In the collaborative writing activity, students seemed confused about the prospect of peer editing. In our future work, student think-alouds and focus groups are required to learn more about students' engagement with the technology. For both activity types, carefully designed scaffolds are needed to improve not only the usability of the technology interface, but also to guide students to engage with the curriculum content – and each other – in ways that lead to improved learning.

References

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