

# Using Participatory Design to Develop Visualizations for Learning

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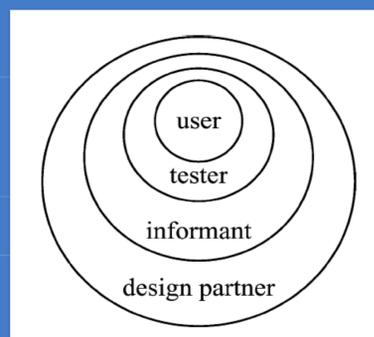
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## ABSTRACT

This poster will describe the learning and design benefits from including teachers and students in development activities involving curriculum materials and simulations. Using participatory design (e.g., Druin & Fast, 2002), we developed our learning activities with students and teachers as design partners through a diverse set of means, ranging from individual informant interviews to larger design sessions that employed cooperative inquiry to blend individual ideas into a larger collaborative framework (Guha et al., 2004, 2005). Our use of participatory design is beneficial because the method allows us to integrate students' and teachers' perspectives early in development to improve the outcome of implementations before they actually occur (Könings et al., 2010). Student and teacher examples will be presented from a current design study involving teacher and student participants in the design *The Connected Chemistry Curriculum*, a secondary science curriculum using simulations and animations.

## What is Participatory Design?

In this process, students are treated as **partners in the design process** – instead of being passive listeners, all participants are expected to be involved in conducting research, sharing outcomes and drawing conclusions. The design partners use their background and experiences to bring new ideas, assess the current design and give opinions on design modifications.



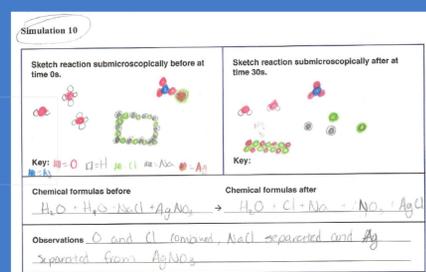
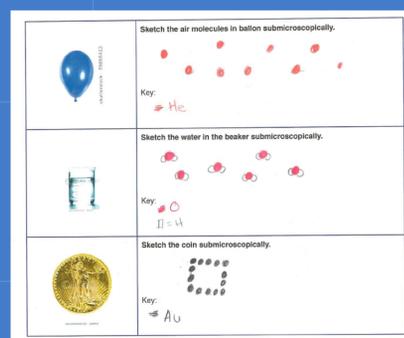
(Druin, 2002)

## 2) What can researchers learn about making the activity flexible?

- For teachers to have a sense of autonomy, the curriculum must convey a sense of flexibility
- Teachers should be given respective choice in how they can complement the curriculum with prior knowledge and personal pedagogies
- Language should not refer back to past activities in the curriculum due to differences in teacher pacing
- Teachers value providing multiple representations of information to maximize student learning and engagement
- Giving students the autonomy and independence to interact with the simulation can increase engagement
- Teachers want to know skills and prior knowledge are needed for both the instructor and the student in detail before starting a given lesson

## 3) What can researchers learn about student learning from working in a participatory design setting?

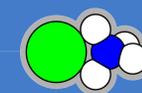
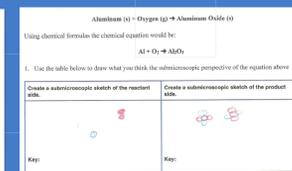
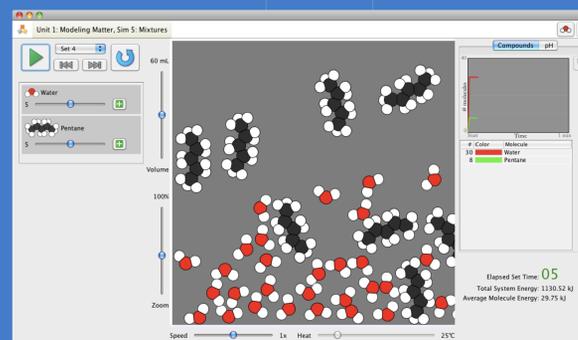
- Students do not readily make their mental models known until researchers ask for further elaboration
- Students have difficulty transitioning visual representations from the simulation to the symbolic level (e.g., formulas), especially in reactions involving ionic solutions



## 1) What can researchers learn about improving the design?

Context A: In two design sessions with researchers, 6 - 8 students between the ages of 12 – 18 designed the simulations

Context B: 4 students enrolled in preparatory chemistry participated in 7 design interviews focused on curricular materials and simulations



Scaffolding and providing info

Sliders and speed control

Need for legends

Clarification

Vocabulary

Literacy Strategies

Similar to common interfaces (e.g., iTunes)

Visual placement of graphs and how to better highlight

Dashboard for units and info

Observational scaffolds

Need for key

Question restructuring

## 4) How do students change or benefit from the collaboration?

- Students see value in receiving additional exposure to chemical content knowledge through the design process
  - S1: Kind of 'cause it was still helping me with my own chemistry struggles. So I mean I still benefit out of it. 'Cause I got to learn new things or understand something better.
  - S3: Well I feel like I learned more about the concepts, like what the molecules actually look like 'cause whenever we learned about chem we never really go through the terms in detail.
- Students feel they have made a positive contribution to the design process and their opinions matter
  - S2: I enjoy the fact that I'm actually making a difference, and I like that I'm actually helping you guys out in improving this.
  - S4: It always makes you feel good about yourself when what you say is being taken into consideration and not just heard. So it's like "Mmm...I made a difference."
- Students see themselves as qualified contributors to the design of the curriculum
  - S2: Participants, our opinions matter. Because its like you're creating it for kids who are in high school, right? And we just got out of high school. So it's like you know we know exactly what you need to get through to the kids.
- Some students become more empathetic and appreciative toward curriculum developers and instructors in science
  - S4: On the analysis side one thing it did show me-I would always question why would teachers show you examples. It seems tedious re-dos of those examples and then give you questions even after that to make you think critically. But it being on the analysis side, it makes sense because it's like now that information is better understood before just going through it in classes-going through books in classes. You're like, "I'm so tired of doing this," but now you can actually see that it's important in the whole learning process.
- Students are able to use what they learned in the design process in relevant contexts
  - S1: In class maybe...like to visually understand something when a professor's saying something I still catch on now. I'm used to the colors and the shapes of the molecules and stuff. So, I can imagine it.
  - S4: I have to balance this and if its really complex sometimes I actually try to envision those little simulation balls.
- Students develop varying levels of ownership and personal investment
  - S1: If I saw it [as if] it was absolutely published or something, I think that would be kind of cool. Like, "Oh yeah. I was in that research interview thing to help them create this."
  - S2: I would [smile]. I would buy it too. I would feel accomplished that I was like a part of it and I helped you know, create this.