



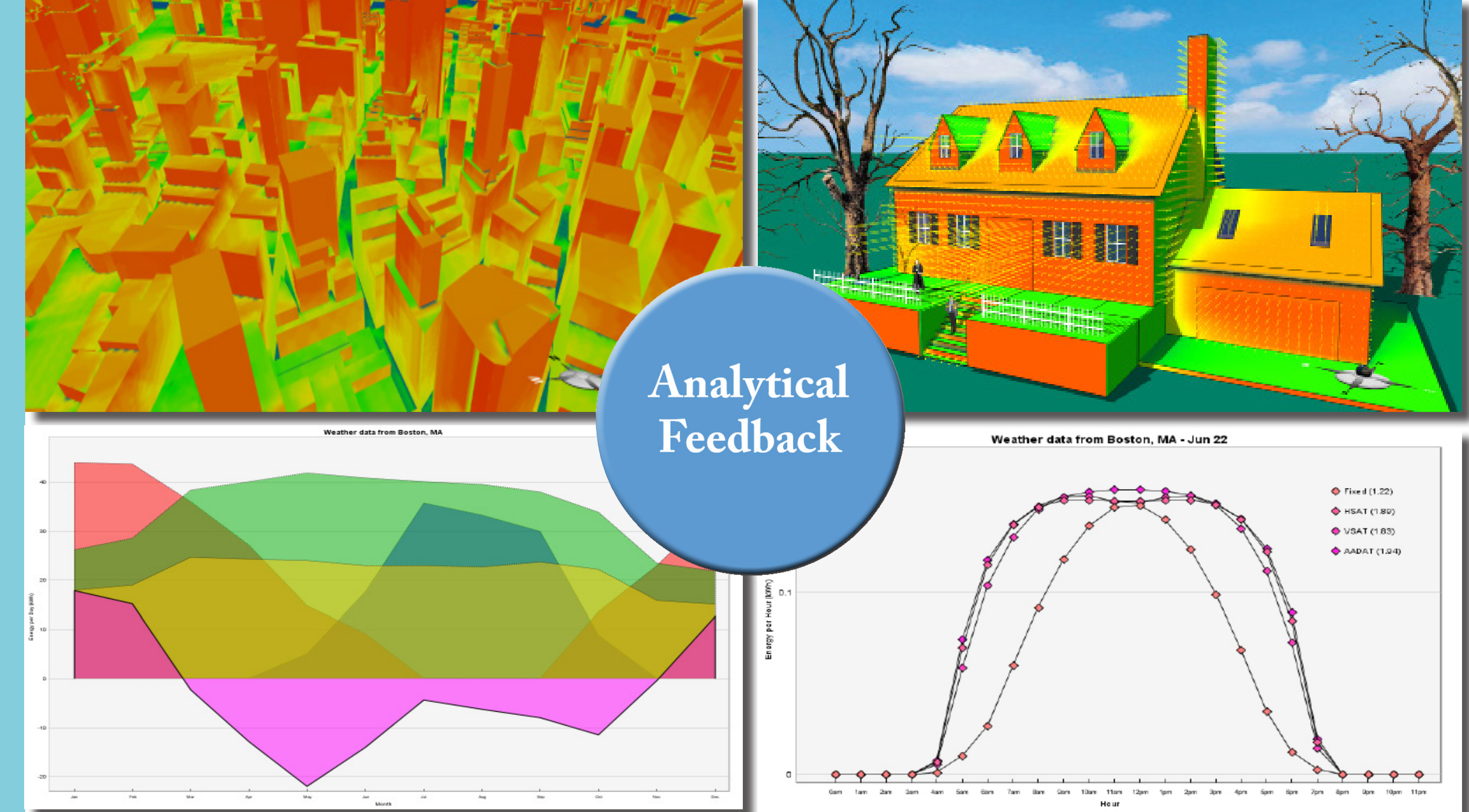
SmartCAD

Guiding Engineering Design with Science Simulations

Charles Xie, Jie Chao, Xudong Huang, Joyce Massicotte, Corey Schimpf
The Concord Consortium

Jennie Chiu, Larry Richards
The University of Virginia

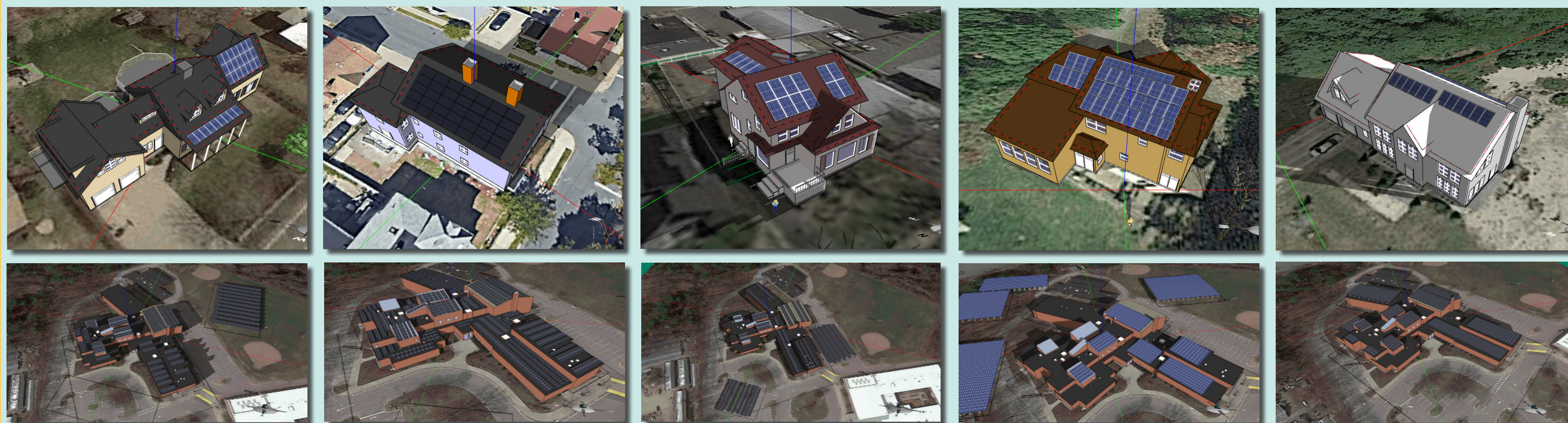
Alejandra Magana, Brenda Capobianco
Purdue University



The goal of this design-based research project is to explore the educational value of science simulations for guiding secondary students through complex, authentic engineering design assisted by “smart” CAD software in classrooms. The research hypothesis is that using science simulations to generate formative feedback for guiding student design will result in three learning outcomes: 1) *Science knowledge gains* as indicated by a deeper understanding of the involved science concepts and their integration at the completion of a design project; 2) *Design competency gains* as indicated by the increase of iterations, informed design decisions, and systems thinking over time; and 3) *Design performance improvements* as indicated by a greater chance to succeed in designing a product that meets all the criteria and constraints. Specifically, we are also probing two research questions: 1) *Feedback types*: What types of feedback from simulations to students are effective in helping them attain the outcomes?; and 2) *Feedback conditions*: Under what conditions do these types of feedback help students attain the outcomes?



Student Work Showcase from Solarize Your Home and Solarize Your School Projects



Project outreach

- 15 schools
- 1,000 students
- 25 teachers
- 20 papers

Student reactions

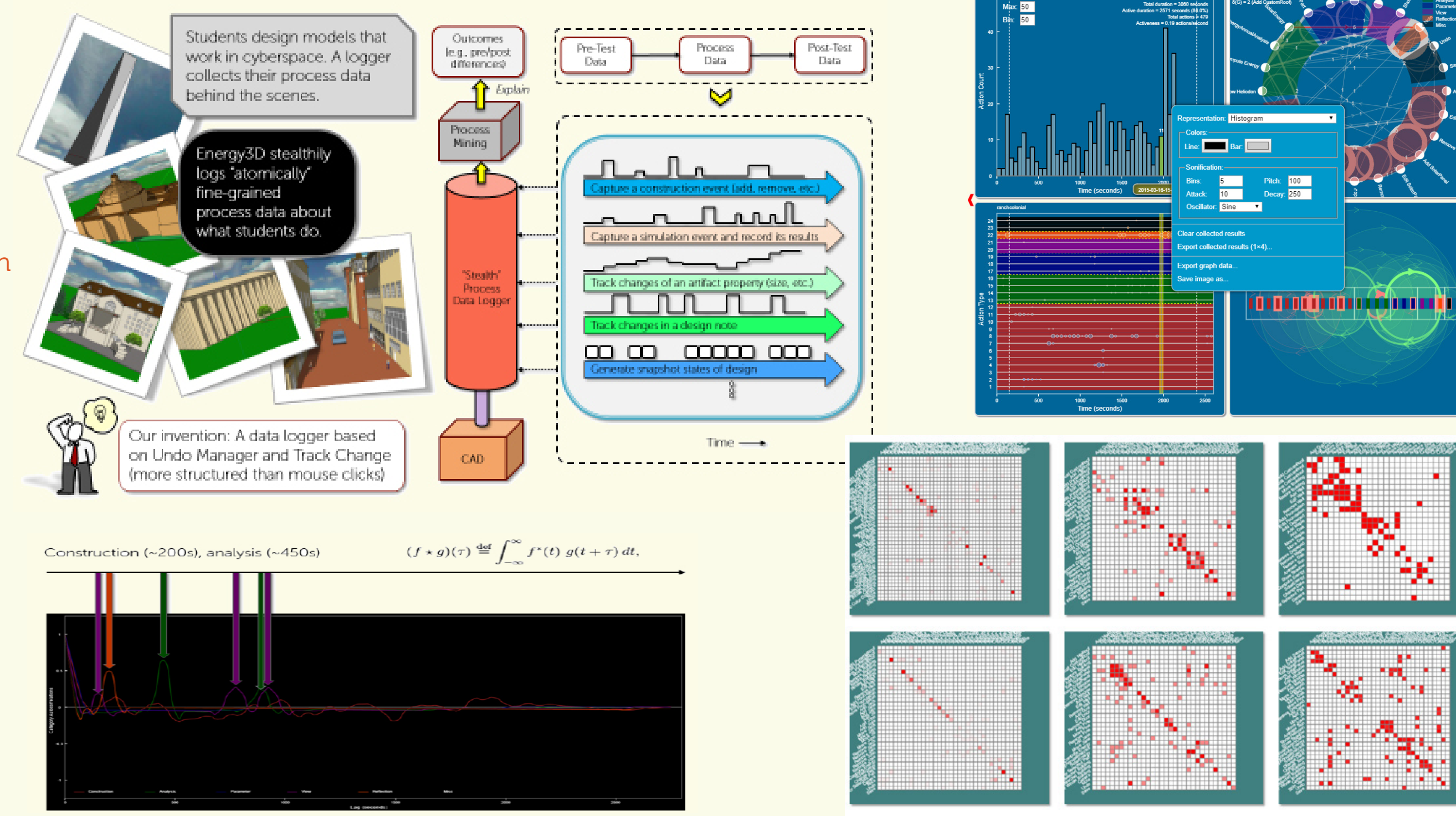
- The thing I loved most about the Solarize Your World project was how realistic it felt. I really liked how you could build your own house and customize it the way you would in real life. I also liked how it wasn't too confusing. Most of the symbols looked like what they actually were. For example, the wall icon up at the top looked like a brick wall and when you clicked on it, that was what it was meant to be.
- What I enjoyed most about the project was that I could build my own house, and work on already existing ones. This was fun because I love to build digitally, but also when I added the solar panels, that was super interesting and I learned some science. It was a win win!



Teacher reactions

- This was one of the best and most memorable professional development experiences I have had in many decades as an educator. Every participant I spoke to felt respected and that they had many useful ways of participating and contributing, and were sent away with an abundance of immediately useful resources.
- Thought it was one of the best conferences I have ever attended and gave some real world projects that can be implemented in my school... the Consortium was great at presenting the info in a useful way.

Data-intensive research



<http://energy3d.concord.org>

