Game-ifying Scientific Concepts of Radioactivity

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Inquiry into Radioactivity - A project of the South Dakota Center for the Advancement of Math and Science Education http://www.camse.org/radiation

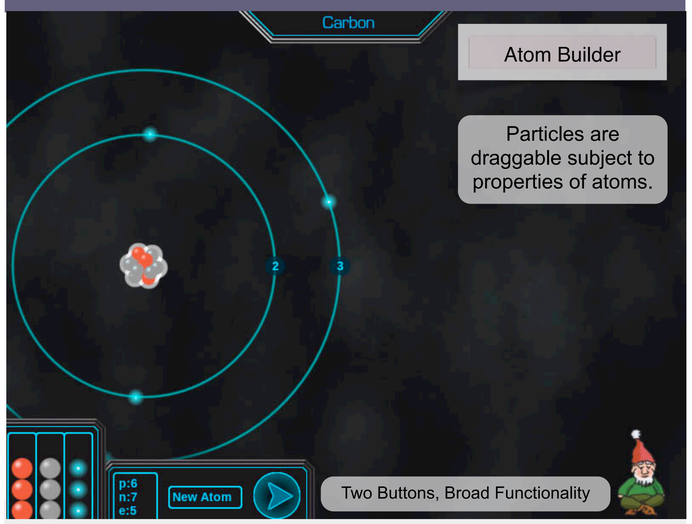
The Inquiry into Radioactivity Project (IiR) developed three computer simulations for investigating atomic phenomena.

Students enjoy using these simulators - when they first encounter the Atom Builder, most student groups play with it for some time before returning to the assignment at hand. Some groups need to be reminded that there is a document to guide them - they seem to be busy "playing the simulator".

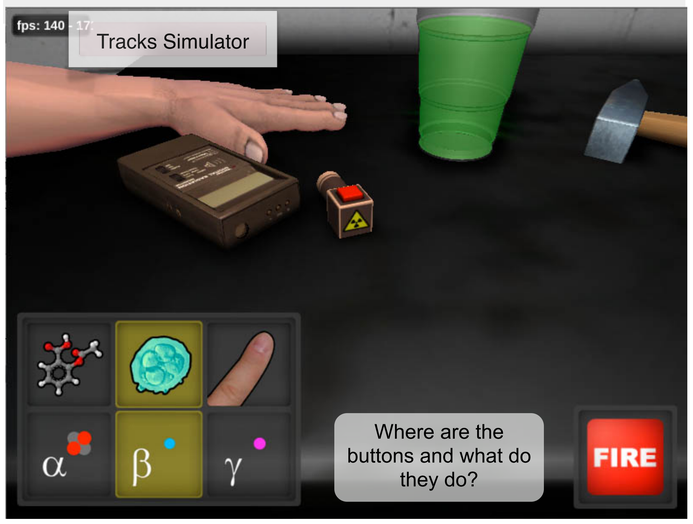
Modern physics education research - like cognitive science - has focused largely on formal learning by individuals. Complications, such as culture, context, history, and emotion, while important, are typically not considered[1].

Perhaps it is time to consider these things. Computer game designers attend diligently to context and emotion; perhaps we can learn something from them![2,3]

"What can I do here?"



- User Interface is intended to be as simple and obvious as possible.
- Dragging, buttons or keyboard controls are based on typical behaviors.



Game Design Principles

- **Usability** - The player can explore the virtual world without any direction. This means the controls must mimic well-known schemes.
- **Attractiveness** - The virtual world looks interesting at first glance, and it offers a steady stream of novelty as it is explored.
- **Difficulty** - There must be some some challenges involved in exploring or interpreting the virtual world.

The Origins of Difficulties

Computer game designers build challenges into games using carefully designed patterns of escalation. This scaffolds the player's abilities and maintains interest. ("*What's the next problem I'm going to encounter?*")

Pedagogical simulators must present realistic phenomena - which can challenge students - but the student experience can be managed via careful design. Educators can maintain interest using similar strategies of escalating difficulties.

Managing difficulty - "The Ruler"

One way to introduce challenges gradually is to use a pattern like the marks on an inch ruler. "a"=easiest, "b"=next difficulty, etc.

a-b-a-c-a-b-a-d-a- . . .

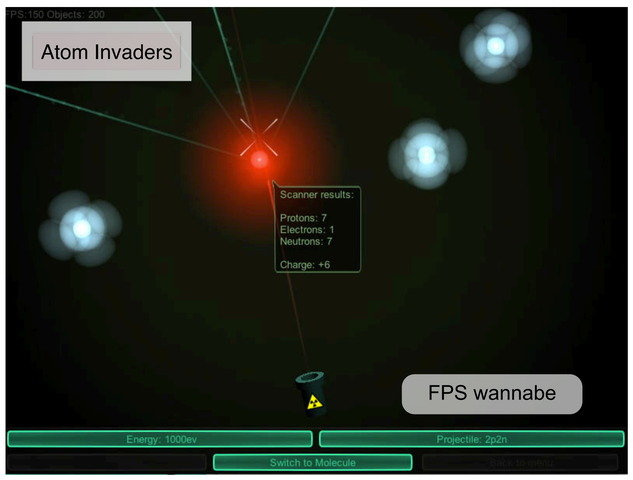
The IiR materials increase difficulty by drawing attention to new simulator behaviors not seen before, or not discussed. The simulators themselves present too many challenges to novices so the IiR materials are used to scaffold student experiences with them.

"Leveling up"

There is no reward scheme built into the system of simulators/course materials.

Currently, all rewards are intrinsic - students come to understand ions, instability, etc. and gain scientific power.

In practice, this seems sufficient for many students.

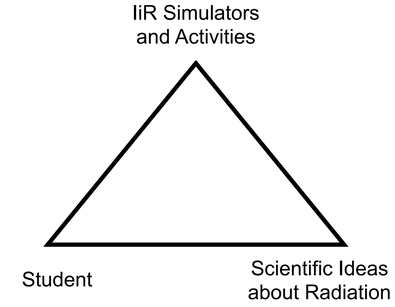


It's not just a game!

Pedagogical simulators have an additional job - they must mediate between the accepted scientific ideas and the students' thinking, and compel thinking that aligns with the phenomena and the scientific ideas.

The IiR simulators make the behavior of atoms, radiation, and molecules visible - similarly to other observations made in the classroom.

Thus, students have to generate their own explanations for atomic behavior.
< < See "Difficulties".



The details of mediation by the system are specific to each situation, but well - managed challenges can maintain student interest and make for deeper and broader learning.

Note

The developer of the IiR simulators is a game developer who learned physics in order to create these simulators. Unity 3D was used to create the sims.

References:

1. Hutchins, E. (1995). *Cognition in the Wild*. Cambridge, MA, The MIT Press.

2. Schell, J. (2008). *The Art of Game Design: A book of lenses*. USA, CRC Press.

3. Adams, E. (2013). *Fundamentals of Game Design*. Berkeley CA, New Riders/ Pearson Education.

The Inquiry into Radioactivity Project at Black Hills State University is supported by National Science Foundation grant DUE 0942699. Any opinions, findings, and conclusions or recommendations expressed in this poster are those of the authors and do not necessarily reflect the views of the National Science Foundation.