The Shape of Things to Come: Visual Analytics for the Assessment of Learning in Video Games

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Motivation
Educational games are being widely adopted to enhance learning. Yet assessment of this learning is primarily done with traditional tests, which don’t reveal how learning was acquired. Meanwhile, educational games produce a rich set of dynamic data that generally goes untapped. We plan to address this deficiency by developing a visual analytics toolset that enables educators and researchers to see patterns in how students acquire and apply knowledge from playing educational games. In addition, our toolset will contribute to an emerging understanding of how students learn from games, and how we can use that knowledge to create more effective learning tools.

Visualization Strategy
A variety of visualization techniques are utilized to provide an animated view of what is happening in a game. The toolset will provide great flexibility, enabling the educator/researcher to easily customize views.

Approach
We have identified 5 broad categories of dynamic game data, produced by all educational games and simulations, that can contribute to our assessment.

- **Player choices** indicate how a student approaches the problem.
- **Player properties** impact - and are impacted by - the effectiveness of the players choices.
- **Player performance** is represented by a score, based on a set of factors determined by the game.
- **Game state** influences - and is influenced by - choices made by all of the players.
- **External events** include player actions - such as conversions and getting help - and events generated automatically by the game.

Tasks
- Implement visualization tools & use with data from our Energy Choices multiplayer online game.
- Conduct usability test with instructors & students using Energy Choices at 3 universities. Use the results to refine design of the visual analytics toolset.
- Use our visual analytics toolset to evaluate other educational games & simulations developed and/or used by our industrial partners.
- Based on results of using the toolset, develop guidelines for designing effective educational games, and algorithms for automatically detecting patterns indicating levels of learning.

Putting this all together, we can view the actions of multiple players (and their results) in an animation that shows the changing state of the game, with one action shape for each player. Here, coordinate axes represent player properties and performance, while the background represents global variables in the game state. Glowing shapes and text annotations can show external events as they occur over time.