

### Choice-Based Assessments

Choice-based assessments give students explicit opportunities to engage in learning behaviors, such as seeking feedback, consulting references, or building a table

- Assess domain-specific and general learning skills
- Designed with different ways to learn
- Provide different information from right/wrong exams and quizzes<sup>1</sup>

### Measuring Scientific Exploration

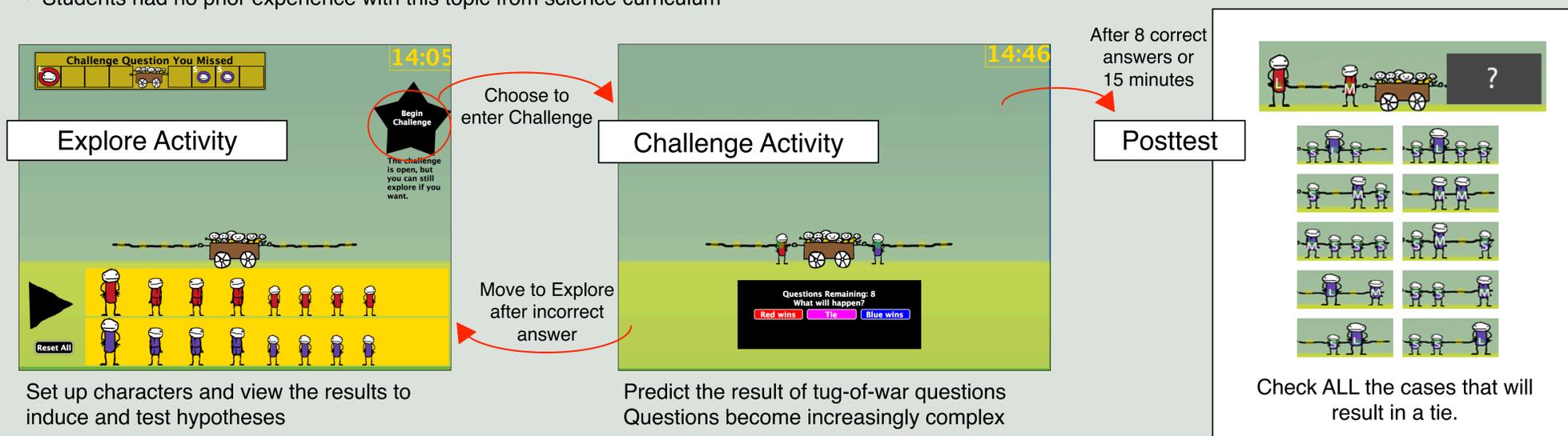
To become scientifically literate, students must engage in exploration and hypothesis testing<sup>2,3</sup>

**We used a choice-based assessment to measure students' exploration choices and investigated how these choices related to learning and academic performance.**

- 91 eighth-grade students participated late in the school year
- Primarily Asian, Filipino, and Hispanic children, 40% low SES

### Tug of War Computer Game

- Science computer game modeled after PhET forces and motion simulation (<http://PhET.colorado.edu>)
- Students needed to predict outcome of a tug of war in a challenge activity.
- To determine who wins, sum the strength values (1, 2, and 3 for small, medium, and big characters). Position does not matter.
- Students had no prior experience with this topic from science curriculum



### Measures of Student Inquiry

#### Opportunities to Explore

Students may choose to run a tug of war simulation or enter the Challenge Activity:

1. When entering the Explore Activity
2. After each simulation run

The total number of these events are a students' *opportunities to explore*.

#### Ratio of Exploring over Opportunities to Explore

$$\frac{\# \text{ simulation runs}}{\text{opportunities to explore}}$$

On average, 44% of each students' opportunities to explore were used for exploration. Students moved directly to the Challenge Activity 56% of the time.

#### Explore Time

Mean time spent to conduct each simulation run

Across the sample, average *Explore Time* was 13.12 seconds (SD = 6.5 s) per simulation run.

### Results

#### In-Game Exploration Choices Relate to Tug of War Posttest

Posttest scores: measure of in-game learning

- Average accuracy = 79%, 27 perfect scores out of 91 students

Successfully completing all challenge questions (n = 79 of 91) leads to better posttest performance,  $t(89) = -2.57, p = 0.01$

*Ratio of Exploring over Opportunities to Explore* positively correlates with posttest,  $r = 0.21, p < 0.01$

- Students who chose to use more exploration opportunities learned more

#### In-Game Exploration Choices Relate to Science Class Grades

8<sup>th</sup> grade science grades: proxy for school performance

- Average class grade = 81%, SD = 9%

*Explore Time* negatively correlates with class grades,  $r = -0.29, p < 0.01$ ,

- Students who spend less time on each exploration tend to have higher grades

*Explore Time* predicts school grade better than posttest performance,  $p < 0.01$

- Choices provide more predictive power than summative measure

### Conclusions

- Inquiry choices predicted learning within and outside the game
- Choices predicted academic performance better than summative assessment

### Future Work

- Pursue more fine-grained analysis of choice patterns using variables to investigate semantics of students' exploration patterns

### References

- 1) Schwartz, D.L. & Arena, D. (2013). *Measuring What Matters Most*. Cambridge, MA: MIT Press.
- 2) Dunbar, K. (1993). Concept discovery in a scientific domain. *Cognitive Science*, 17, 397-434.
- 3) National Research Council (2007). *Taking Science to School: Learning and Teaching Science in Grades K-8*. Washington, DC: National Academy Press.

### Acknowledgements

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