

## **Educational Games in the Classroom: Design-Based Research and Methods for Classroom Mediation**

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**Abstract:** Educational games are becoming popular tools teachers use in the classroom to improve students' learning and understanding. This poster describes a large, ongoing design-based and mixed-methods research study that examines the best practices for using games in the classroom. We created three video games that target fraction learning. We aim to study the affects of these games on learning and engagement in the classroom and to understand what contexts facilitate the greatest math learning.

### **Introduction**

This research is part of a collaboration between computer scientists and learning scientists. The learning science teams conduct classroom-based research to study the games, and as findings are discovered, those results are shared with the computer scientists who quickly revise the games for continued use and study in the classroom. The affordances of technology and our close collaboration allows us to rapidly iterate on both game design and study design as a means to track and improve the use of games in the classroom.

In the 2012-2013 school year, our group conducted eight classroom-based studies. Our chief goal is to help students productively engage in the discipline of math as a means to improve their conceptual understanding of fractions. The research questions guiding the studies are: 1) What do different uses of the games look like in different classrooms?; 2) If we see different learning outcomes with different implementations, how were those implementations qualitatively different?; 3) What implementation processes should be repeated to reproduce learning gains in other classrooms?; and 4) How should both study and game designs change when statistically significant learning gains are not produced?

### **Theoretical Framework**

Our research is supported by sociocultural theories of learning, which examine the cultural and contextual nature of human development (Bronfenbrenner, 1979; Lave & Wenger, 1991; Rogoff, 2003; Vygotsky, 1978). In our studies we are mindful of the overall "ecology" of gaming as described by Salen (2008), therefore we do not study games without regard to the context in which they are played. Looking at the learning ecologies allows us to think of gaming beyond just the game and play state to also consider the game and its context as a complex system.

The social interactions and supports that occur during game play help players figure out the game in very different ways (Steinkuehler, 2004). Players playing together online or alone-together online (i.e. MMO) support each other differently than those playing a multi-player console game in the same physical space, and different still from those playing single-player games together in the same physical space (Salen & Zimmerman, 2003; Stevens, Satwicz, & McCarthy 2008).

### **Methods**

Aligned with our framework, we employ a design-based research methodology (Penuel, Fishman, Cheng, & Sabelli, 2011; Sandoval & Bell, 2004) to study these complex systems and revise both our games and environments as we learn and change. Our systematic investigations are iterative and collaborative, and we are concerned with developing theory related to how games can best be used in the classroom.

### **Findings**

There are three categories of studies: 1) Unmediated game play studies, 2) Peer mediated game play studies, and 3) Teacher mediated game play studies.

#### **Unmediated Game Play**

Overall, we did not find significant learning gains for unmediated game play (i.e., game play without teacher intervention and without peer support). These findings led us to move away from unmediated game play in the classroom, towards the use of peer mediated game play. Our game designers programmed a two-player version

of *Creature Capture* for the study of peer mediated game play. In addition, we tested the use of *Refraction* if played in pairs (although the game was not redesigned for this use).

### Peer Mediated Game Play

The second set of studies examined peer mediated game play. In these studies students played the games with a partner as a form of additional support but without supporting classroom activities surrounding the game. As expected, peer-mediated game play was associated with statistically significant gains on the assessment for some groups and more math talk than unmediated game play. While peer mediated game play was an improvement, we were interested in exploring the contexts and conditions that affect learning via the use of games. As a result, we examined the impact of teacher mediated game play on student learning.

### Teacher Mediated Game Play

The third set of studies are those for which teachers integrated the games into their classroom instruction. In general, the lower performing students, who received more focused instruction, produced statistically significant learning gains. As a result, this led us to create more focused teacher-led interventions around the games.

### Discussion

These studies tell a story of continued improvement in study design, game design, and student learning over the course of a year. Two types of learning occurred as a result. The first was continual research learning in the context of the designed based research. With each study iteration, we were able to draw new conclusions, create new hypotheses, and quickly test those out in the classroom. The second level of learning relates to student learning. As we increased the level of structured mediation around the gameplay, students learned more.

### Implications

First, for teachers who use games in the classroom, our findings help demonstrate that using games in isolation may not be the best use of games in the classroom for learning. Instead, structuring game play and the game play context in a way that is more deliberate and planned, and with the inclusion of peer or teacher mediation, will likely promote more student learning. Second, we are moving towards a more careful understanding of what types of teacher mediation and classroom contexts are most helpful for student learning. We believe that directed lessons around the games might be the most beneficial.

### Relevance to the Conference

Our study and our process embody the ideas of learning and becoming in practice. For the students, we aim to foster learning that promotes students engagement with mathematics and math talk as a means to productively engage with the discipline. As researchers, using design based research is one way in which we are constantly learning and improving in our practice.

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