

# Game-Enabled Agency: Outcomes that Matter

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**Abstract:** The Doctors Cure learning experience is a 3D immersive game that positions players as protagonists in a virtual world where they must use their understanding of persuasive writing and how to gain evidence from complex texts in their role of investigative reporter. We report on the underlying educational theory, the game itself, and, to justify its impact, share data from a comparison study with 8 7<sup>th</sup> grade classes assigned the control and 8 assigned the experimental conditions—about 450 total kids, 90% receive free-and-reduced lunch and 87% are Hispanic. While both the game-based intervention group and the control showed statistically significant learning gains on short-answer and multiple-choice items, the intervention group demonstrated statistically significant gains with a large effect size on an open-ended persuasive essay task. Differences in engagement and learning are credited to player agency, affordances of the embedded scaffolds, and the power of consequential outcomes.

## Statement of the Problem

There is currently a sizable gap in innovative, engaging, high-quality products designed to help middle school students build writing skills in a manner consistent with the Common Core. Specifically, literacy skills in the United States are failing to keep up with growth in other countries (Thompson et al., 2012) with a third of US 8th graders being proficient in reading and writing (National Center for Educational Statistics, 2011, 2012). More generally, every 9 seconds, an American student drops out of school, more than a million every year. One of the primary reasons youth cite for dropping out of school is a lack of engagement, thanks to the perceived lack of relevancy of the school curriculum to their lives. We need new curriculum models that excite and inspire youth, not simply to remember or even apply academic content, but to foster in them a confidence and commitment to use academic concepts (like those articulated in the Common Core Standards - CSS) in their own lives.

This requires the creation of new curriculum based on innovative learning theory, and that is intended to position academic content, individual learners, and those situations in which the content has value as interrelated. Videogames in particular are being touted as providing a powerful learning technology with the potential to transform education (Barab, Gresalfi, & Ingram-Goble, 2010; Gee, 2003; Shaffer, 2009; Squire, 2006), with many educators, researchers, designers, and even industry partners working to develop new forms of game-based curriculum. This is, in part, because games offer a well-designed mix of challenges, rewards, and goals that drive motivation, time-on-task, and levels of engagement that can seamlessly move back and forth between formal and informal learning environments. Games can make learning engaging, social, and relevant.

At the core of our theory of change model is that learning is not simply the acquisition of literacy skills cognitively, but involves meaningful participation in which the learner applies their emerging competencies within a situation in which they have agency and consequentiality to accomplishing something they value (Barab, Gresalfi, & Ingram-Goble, 2012; Brown, Collins, & Duguid, 1989; National Research Council, 2002). They can give students real agency in ways that static textbooks simply cannot. Beyond addressing the engagement and relevancy challenges, games are also well positioned to address key foundational skills such as those specified in the Common Core Standards.

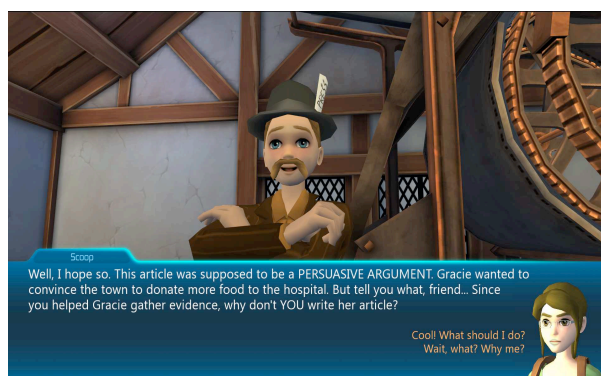
## Theoretical Framework

The philosopher and educator John Dewey (1938) supported a transactive view of schooling, where learners are active change agents rather than passive observers, and through their actions and consequences, they transform the problem into a known. Technology has finally caught up to Dewey's vision, and we now have tools that make it possible to individualize learning and provide authentic tasks and roles to students, particularly in the field of game-based learning. Digital games are different from other media in that they are interactive, participatory and highly engaging. They enable players to step into different roles (e.g. scientist, explorer, inventor, political leader), confront a problem, make meaningful choices, and explore the consequences.

Through immersing players in virtual worlds designed to support deep and engage learning, there is real potential to position students (even in the context of schools) as agents-of-change who use real-world knowledge, skills, and concepts to make sense of a situation and then make choices that actually transform the play space and themselves; creating a place in which *what you know* is directly related to *what you are able to do* and, ultimately, *who you become* (Barab, Gresalfi, & Arici, 2009). Further, games have the potential to provide the learner a motive and motivation for pursuing this expertise, with consequential feedback on their

strategies, strengths, and even their own evolving identity (Barab, Gresalfi, & Ingram-Goble, 2010; Gee, 2003; Squire, 2006; Steinkeuhler, 2006).

Many of the strengths of game-based learning can be summarized in the theory of *Transformational Play*; a 3-fold theory that positions the *person* with intentionality, the *content* with legitimacy, and the *context* with consequentiality (Barab, Gresalfi, & Ingram-Goble 2010). Transformational play as a theory has emerged through our design and research on games for learning. The idea of transformational play highlights relations among the three interconnected elements of person, content, and context. In these games, learners become virtual protagonists who use the knowledge, skills, and concepts of the educational content to first make sense of a situation and then make choices that actually transform the play space and the player—they are able to see how that space changed because of their own efforts.



**Figure 1.** Screenshot from Doctors Cure.

Such play is transformational in that it changes the context in which play is occurring, at the same transforming the player and his or her potential to interact with the world. When creating learning environments to bring about transformational play, we use game-based technologies to position person, content, and context in the following ways:

- Person With Intentionality (positioning players as protagonists with the responsibility of making choices that advance the unfolding story line in the game)
- Content With Legitimacy (positioning the understanding and application of academic concepts as necessary if players are to resolve the game-world dilemmas successfully)
- Context With Consequentiality (positioning contexts as modifiable through player choices, thus illuminating the consequences and providing meaning to players' decisions)

In this way, gaming technologies now make Dewey's vision a reality, putting learners as active protagonists in their own learning, taking on authentic roles via avatars, and seeing the consequences of their actions played out in a 3D immersive world.

## Atlantis Remixed: The Doctor's Cure

Informed by this theory, and to further investigate its underpinnings, we evolved a 3D immersive role-play game for learning literacy skills, called "The Doctor's Cure." While based on previous work (Barab, Pettyjohn, et al., 2012), in this study we have designed a new engine with powerful new learning affordances including pedagogical scaffolds, embedded assessment, and a powerful argumentation mechanic and tool. This game is embedded within the Atlantis Remixed (ARX) Project, an international learning and teaching project that uses 3D virtual environments to immerse children, ages 9-16, in educational tasks (the second generation of Quest Atlantis). Through interactions with in-game mentors (non-player characters, or NPCs) and by using in-game tools to engage the academic content, the students are given the scaffolds and affordances necessary to take on the role of an expert in an authentic task and make influential decisions, which they see played out in their virtual world.

"The Doctor's Cure" (TDC) is a literacy game based on Mary Shelley's novel *Frankenstein*, and set in a gothic world, where students take on the role of an investigative reporter via their avatar, and complete a series of missions to uncover a moral dilemma involving Dr. Frankenstein's work. As reporters, students actively collect evidence through interviews and investigations, build logical arguments to support their theses, submit these to an in-game logic machine for evaluation, and get feedback about the alignment between their evidence and reasoning. Players are intentionally positioned as agents of change whose purpose is to help the village of Ingolstadt decide if they should allow "Dr. Frank" to keep looking for a cure in spite of his questionable research methods. Players soon learn that persuasive writing is a necessary tool to resolve the

game's narrative conflict. As the game progresses, players experience how their choices and use of persuasive writing dramatically change Ingolstadt, its citizens, and even the students' own identity as a writer and leader.

In-game tools provide support in the interrogation of texts, as well as a model for testing the logic of their argument, and immediate feedback in the process. One of the pedagogical scaffolds in the game is the 'Lens of Lumination' tool (see Figure 2), which allows students to examine texts above their current reading level. The Lens of Illumination is designed to help the player engage in meaning making by "illuminating" the relevant claims in the documents, so players can decide if they want to collect that evidence. Once players have gathered what they think is a good collection of evidence to support their thesis, they visit Scoop Perry, and use his Persuasive Argumentation Tool (PAT), which displays all the evidence they have collected thus far, they then drag-and-drop their evidence to match their claims, and create a chain of logic to support their thesis (see

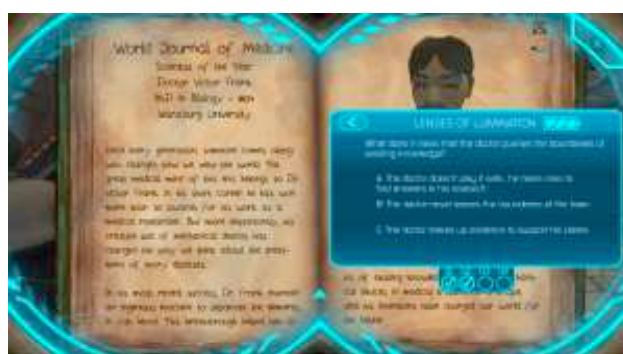


Figure 2. Screenshot of the Lens of Lumination.

Figure 3). The immediate feedback and flexibility of the tool allows players to move elements around easily, repeat and test various logic orders. Once sound, players proceed with the game and write their persuasive essay for the town newspaper, to convince the townspeople of their view. These tools are a small part of the much larger narrative.



Figure 3. Screenshot of the argument tool.

Consistent with our notion of games as a service, we provide a teacher toolkit and dashboard that allows teachers to easily manage their classes: registering students, assigning content and reviewing student work. This toolkit will build on the existing work done for the Atlantic Remix platform. This system provides ongoing data to teachers about the state of student gameplay, a review interface for evaluating and providing feedback on student work, as well as access to other relevant choices that can be used to support class discussions or Socratic dialogues with students.

Below is an image of the progress tracker, in which teachers can monitor what task and mission student is working on. Also below, is an example of the teacher feedback in which they can use a rich text editor to leave feedback and notes in the body of the student essay, or as a formal review on the side panel in the guise of an in-game character (e.g., Scoop). The fact that both the student work and teacher comments can be accessed and edited via basic html allows for continual feedback to support students in the writing revision process. At any point teachers can click on the blue button and see the supporting data that the students used to craft their essay. More than listing of facts the students have collected, teachers can see the actual embedded assessment and conceptual models that students generated while they were working through the game.

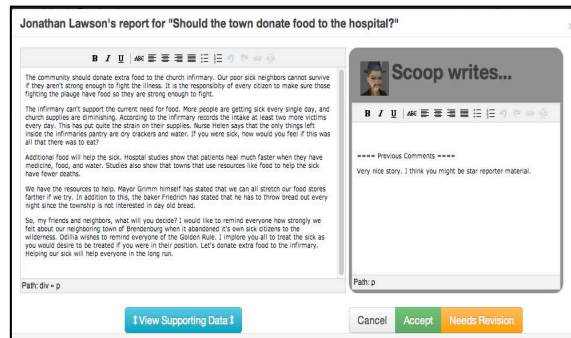


Figure 4. Teacher Feedback on Student's uploaded essay.

Progress Reports Summaries Evidence Choices Meters						
Student	Username	Intro	M1	M2	M3	M4
Bellin, Erica	ebellin					
Bateson, Philip	pbateson					
Curtice, Brian	bcurtice					
Elochs, Jordyn	jenochs					
Gulian, Kristoffer	kgulian					
Henry, Jeffrey	jholmes					
Henry, Matthew	huemas					
Kim, Younsu	yskim1					
Lawson, Jonathan	jrlawson					
McCoy, Lisa	lmccoy					

Figure 5. Class Mission Progress.

## Methodology

### Study Overview

To test the theory of Transformational Play, we implemented The Doctor's Cure game across a school district of 7<sup>th</sup> grade Literacy classes. This study compared a 3D gaming curriculum and context with that of a similarly novel curriculum based in the graphic novel *Frankenstein*. Interview measures showed the graphic novel to be incredibly popular, and equal to the game-condition in its engagement measures. The comparison study was a quasi-experimental design of intact classes, with 8 classes assigned the control and 8 assigned the experimental conditions—about 450 total students with just over 400 completing the pretest and the posttest.

### Participants

This school district, located in the southwestern United States and bordering on Mexico, is a fairly large district with more than 18,000 students, many disadvantaged, and have a demographic breakdown that includes 95% minority groups (87% being Hispanic), 83% low socio-economic status, and 20% English Language Learners. Additionally, the community recently approved over \$25 million dollars in bonds for technology upgrades, bringing one-to-one laptops to all students. Participants were 12-13 years old.

### Measures

Measures included traditional instruments, quantitative assessments, as well as ethnographic techniques. Learning gains were measured by a pretest and posttest, which were identical for both conditions, and counterbalanced within conditions. Questions varied from lower level multiple choice, to short answer, to a final essay writing question, where all students crafted their own persuasive essay with a given prompt. A rubric was created to analyze all open-ended responses and two raters scored a subset of tests with an interrater reliability of  $\alpha = .81$ . To quantitatively assess the engagement of the learner, a student self-report measure was gathered. This Engagement Questionnaire was based on that of Csikszentmihályi's (1990) study with 'flow', where he interrupted students involved in various activities to respond to their current state of engagement, motivation and challenge in the task at hand.

## Results

### Learning Data

A repeated measures ANOVA on the multiple choice/short answer test revealed a significant main effect for testing time,  $F(1,402)=46.25$ ,  $p=.000$ , a non-significant main-effect for condition,  $F(1,402)=1.72$ ,  $p=.191$ , and a non-significant interaction,  $F(1,402)=.07$ ,  $p=.793$ . In other words, while both the control and experimental groups demonstrated statistically significant learning gains on the *multiple choice/short answer tasks* with small/medium effect sizes (Con ES=.33, Ex ES=.33), there were no differences for group gains. See Figure 1, left side. A repeated measures ANOVA on the *persuasive essay task* revealed a significant main effect for testing time,  $F(1,353)=14.47$ ,  $p=.000$ , a non-significant main-effect for condition,  $F(1,353)=.87$ ,  $p=.350$ , and a significant interaction,  $F(1,353)=18.32$ ,  $p=.000$ . Follow-up analyses indicate that while the control,  $t(167)=.36$ ,  $p=.72$ , did not have statistically significant learning gains, the experimental condition,  $t(187)=5.73$ ,  $p=.000$ , improved significantly with a moderate effect size (ES=.51) from pre-post on the essay writing task (see Figure 1b). See Figure 1, right side.



Figure 6. Learning Gains: Left side is comparison of groups over time on multiple choice/short answer. On the right side is comparison of groups over time on essay prompt.

These data show that both the comparison (graphic novel) group and the experimental (game) group had significant learning gains from pre to post test on low-level concepts related to literacy and persuasive argumentation. That is, both groups were able to identify and describe the basic elements of persuasive writing equally well. However, when looking at the final essay composition, requiring the highest levels of thinking, application, synthesis and evaluation, the students in the game condition students scored significantly higher in their compositions.

These findings lend support for Transformational Play, in that students who were actively engaged as first-person protagonists in the game narrative, with an authentic role and purpose for writing persuasively, did better in their writing than did those who had similar assignments based around a passive narrative in a graphic novel. Further, the game students had the contextual tools embedded in the virtual world to help them make sense of the evidence and create meaningful logic models. Students later demonstrated they were able to write persuasively even in the absence of these tools on the posttest, suggesting near transfer of these skills to a non-game context.

### Engagement Data

We collected engagement data using a modified version of Csikszentmihalyi (1993) flow's instrument that consisted of 7 Likert-type questions (e.g., did you enjoy what you were doing, was the activity challenging, were you succeeding at what you were doing) and had .77 internal consistent using Cronbach's Alpha. Results showed that there were statistically significant differences between groups,  $t(125)=5.41$ ,  $p=.000$ , with the experimental group ( $M = 3.86$ ,  $SD = .62$ ) outscoring the control group ( $M = 3.29$ ,  $SD = .58$ ) with a large effect size (ES=.95). Additionally, a Chi Square carried out on data in which students were asked: "What was your main reason for doing the task?" Results were significant, with the distribution being statistically different from chance,  $X^2(121)=35.67$ ,  $p < .001$ . In fact, 74% (49/66) of students in the treatment condition attributed that choice to "because I'm interested in the task," as opposed to 22% (12/55) of the control. In contrast, 75% (43/55) of the control chose either "to get a grade" or "my teacher told me to," while only 23% (17/66) of the treatment condition chose this option. These findings are summarized in Table 1.

Table 1. Engagement Data. When students were asked “What is your main reason for doing this task?” a significant number of game-based students attributed it to being intrinsically interested in the task, rather than for an external grade or teacher direction.

Attribution	Treatment (Game)	Control (Graphic Novel)
‘I’m Interested in task’	49 (74%)	12 (22%)
‘Teacher told me to do it’	2 (3%)	14 (26%)
‘To get a good grade’	15 (23%)	28 (51%)
‘Other’	0 (0%)	1 (1%)

## Qualitative Lessons

Interviews and written feedback were collected from the students throughout the implementation, and at its conclusion. When asked to describe their experiences in this unit, these are comments that are representative of the most commonly offered from students. First, there were several reactions that were similar for both the Game and the Graphic Novel students. Both groups described the experience as:

- “Challenging”, “Engaging”, “Fun”, “I am learning a lot”.
- “It will help improve my writing”,
- “This is something I’d like to continue on my own”.
- “When the story ended, I was shocked because I wanted to read more” (Graphic Novel)
- “Once I finished the game I was like, “Aw, man!” I wish there was another part. It was cool and fun to play.” (Game condition)

In fact, both conditions continued to access the games and novels after the study ended, and switched to participate in the activity they were not originally assigned.

Next, there were some reactions that were more isolated to only the Game Condition students. The following are representative reactions to the game that differed from the graphic novel condition, with categorical interpretations in parentheses:

- “I’m surprised that they let us play this game at school!” (engagement)
- “The game involved a lot of reading and writing.” (challenge)
- “I look forward to see what is happening next, and how it will turn out.” (consequentiality)
- “My opinion about who is right and who is wrong has changed over time.” (multiple perspectives)
- “I’m investigating the other side of the debate now.” (active participant, multiple perspectives)
- “The people agree and disagree with the Doctor. It will be interesting to see how they act after my article is published!” (embodied role, multiple perspectives)
- “I like it because it gives you some feedback and you can go back to fix it.” (engagement)
- “The game helps me be much more persuasive, so I can convince the people [in the game] about what I’ve found [as an investigative reporter].” (embodied role, engagement)
- “I’m looking forward to writing my essay so I can convince people that they should support the doctor!” (strong opinions, motivated to articulate)
- Some felt strongly that the doctor should not experiment on the creature because he has rights. Others felt that the ends justified the means, and the cost of the creature was worth saving the thousands of others from the plague. Others took middle ground, suggesting alternative ways to find a cure for the plague.

Game classes were incredibly on-task, and had little conversation going on that wasn’t related to the game. Many students were up and helping others, cooperating in game play, and celebrating when they were successful. The field observations and interview data are encouraging in that they further support the strengths of Transformational Play. While space limits prohibit extensive transcripts here, we will briefly overview three findings.

Importantly, teachers felt both conditions were equally engaging to students, with some teachers even arguing that the graphic novel might have been more exciting to students:

I think the kids found the game engaging, but they found the graphic novel equally engaging too. I think the difference is in the game **they also feel empowered**, even though I think that their world in the graphic game was in some way, I think, overwhelming. And it wasn’t so much the ‘3D-ness’ of it, as much as **they saw direct cause and effect**...They’re exploring the world at that age, of “**Can I make a difference?**” The first time they do something or write something that makes a difference, they think “**That was a real big deal!**”



However, what really seems to be powerful from this teachers' perspective was how the game provided player agency, consequentiality, and a sense of purpose that was relatively absent in the novel condition. More generally, one of the key observations was the sense of purpose or intentionality that students in the gaming condition as they often discussed the importance of their essay in accomplishing their goals. Reflecting across the field notes, the following three areas seemed to be especially important with respect to motivation learning and engagement.

### **Pedagogical Scaffolds**

The pedagogical scaffolds and in-game tools were key for student success. Teachers and students reported how much they loved the scaffolding tools in the game, and the feedback they received on the quality of their logic model. Teachers felt that this was the largest contributor to student success in argumentation. The ability for students to drag and drop ideas alleviated much of the language barrier present in this population of students, and they could focus on just the logic model itself.

### **Consequential Feedback**

One of the most engaging aspects of the experience for students was the consequential feedback they received around their choices. When players made a choice or performed a series of actions and the game responded, they would literally "hoot" out loud, or laugh and look around at other computers. We saw numerous examples of students discussing different outcomes with each other in the classroom, hallway, or in some cases we heard about students still discussing choices at home. As the unit progressed, a number of students' enthusiasm started to wane, however, and we need to figure out better ways of providing reinforcement and successes to keep students engaged for longer periods.

### **Professional Development**

Game-based learning brings with it new pedagogies. Teachers need training in how to provide valuable feedback on student work, how to use embedded data in the system to support meaningful class discussions, and what is one's role and responsibilities for successfully implementing a game-infused curriculum. More generally, teachers needed ongoing support to engage the system successfully. Simply training them before implementation was inadequate, and we found that prompting teachers to review student work, to probe student understanding, and to provide just-in-time lectures was necessary.

### **Significance**

The Doctor's Cure was created and grounded in the theory of Transformational Play, leveraging the three interconnected elements of *person*, *content*, and *context* in immersive gameplay. This study explored the nuances of learning and engagement, when those three elements are supported, demonstrating significant learning gains and deeper engagement at higher levels of authentic practice. Qualitative findings uncovered additional strengths, such as the in-game tools for providing practice and fluency in working through difficult logic models and complex texts. However, teachers need additional support to shift their pedagogy into a game-based approach. Importantly, this study took place in a challenging context with mostly struggling learners, and with a high percentage of at-risk learners who frequently opt out of school, in part because the lack of meaning with respect to academic content in terms of their personal lives. Through the game we were able to establish a rich context for learning that justified the use-value of the content, and gave these youth a sense of consequentiality to their learning and to potentially to their sense of self. We see this as an invaluable component of games.

Importantly, however, is that players are able to use this new found confidence and ability, to realize goals in their own lives outside of the game world or school. While constructing an individual bounded game has the potential to result in strong engagement and foster desired learning outcomes, central to our theory of change is to expand this vision of impact games to think of the medium as on-going services that support multiple game-infused experiences and real-world extensions where core lessons are brought outside the fictional gaming context. In this way, we are currently building in more features to scaffold rich conversations around the game play—multiuser experiences and collaborative smart tools to facilitate player interactions.

We are also adding in professional networks and the ability to extend the lessons learned but also the scaffolding tools into the real-world where players can build logical arguments and eventually support change in their own community. This involves, for example, having online profiles where one's professional network begins with "achievements" that are taken from the game world, and then as they use the argument tool on interest-driven agendas are able to expand towards accomplishing real-world goals in their community. A key challenge here is to balance player agency and emergent situations with productive constraint, and providing

designed experience where they can level up in ability, and build the necessary confidence and commitment to persist on complex real-world tasks.

## References

- Arici, A. (2009). Meeting kids at their own game: A comparison of learning and engagement in traditional and 3D MUVE educational-gaming contexts. Unpublished doctoral dissertation, Indiana University, Bloomington.
- Barab, S., Gresalfi, M. and Arici, A. (2009) "Transformational play: Why educators should care about games". *Educational Leadership*, 67(1), 76–80.
- Barab, S., Gresalfi, M., and Ingram-Goble, A. (2010) "Transformational play: using games to position person, content, and context", *Educational Researcher*. v39 i7. 525-536.
- Barab, S.A., Pettyjohn, P., Gresalfi, M., Volk, C., & Solomou, M. (2012). Game-based curriculum and transformational play: Designing to meaningfully position person, content, and context. *Computers & Education* 58(3): 518–533.
- Csikszentmihályi, M. (1996) *Creativity: Flow and the Psychology of Discovery and Invention*, New York: Harper Perennial, ISBN 0-06-092820-4.
- Dewey, J. (1938). *Experience & Education*. New York, NY: Kappa Delta Pi. ISBN 0-684-83828-1.
- Gee, J. P. (2003) *What video games have to teach us about learning and literacy*. New York: Palgrave.
- Halverson, R. (2005) *What can K-12 school leaders learn from video games and gaming?* Innovate. 1(6).
- National Center for Education Statistics. (2011). *The Nation's Report Card: Reading 2011 (NCES 2012–457)*. Washington, D.C.: Institute of Education Sciences, U.S. Department of Education.
- National Center for Education Statistics. (2012). *The Nation's Report Card: Writing 2011 (NCES 2012–470)*. Washington, D.C.: Institute of Education Sciences, U.S. Department of Education.
- Shaffer, D. W. (2007) *How computer games help children learn*. New York: Palgrave Macmillan.
- Squire, K. (2006) From content to context: Videogames as designed experience. *Educational Researcher*, 35, 19–29.
- Steinkuehler, C. A. (2006) "Massively multiplayer online video gaming as participation in a discourse". *Mind, Culture, and Activity*, 13(1), 38–52.
- Thompson, S., Provasnik, S., Kastberg, D., Ferraro, D., Lemanski, N., Roey, S., & Jenkins, F. (2012). *Highlights From PIRLS 2011: Reading Achievement of U.S. Fourth-Grade Students in an International Context (NCES 20131010)*. Washington, D.C.: National Center for Education Statistics, IES, U.S. Department of Education.