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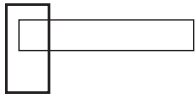
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Transformational Play: Using Games to Position Person, Content, and Context

Sasha A. Barab, Melissa Gresalfi, and Adam Ingram-Goble

Videogames are a powerful medium that curriculum designers can use to create narratively rich worlds for achieving educational goals. In these worlds, youth can become scientists, doctors, writers, and mathematicians who critically engage complex disciplinary content to transform a virtual world. Toward illuminating this potential, the authors advance the theory of transformational play. Such play involves taking on the role of a protagonist who must employ conceptual understandings to transform a problem-based fictional context and transform the player as well. The authors first survey the theory and then ground their discussion in two units that, as part of their design-based research methodology, have simultaneously given rise to and been informed by their theory of transformational play. They close with a discussion of research and design challenges.

Keywords: computers and learning; instructional design/development; instructional technologies

Much has been written about the educational potential of games (Gee, 2003; Shaffer, 2007; Squire, 2006; Steinkeuhler, 2006), and we are seeing numerous efforts to design serious games that teach academic content—many of which are in use in classrooms (see, for example, Dede & Barab, 2009; Rosenbaum, Klopfer, & Perry, 2007; Squire & Jan, 2007; for a review, see Clark, Nelson, Sengupta, & D'Angelo, 2009). In particular, scholars have documented the complex forms of learning and participation that can occur during game play—its discursive richness, depth of collaborative inquiry, opportunities for consequentiality, rich perception–action cycles, and exploration of situated identities (Gee, 2003; Shaffer, Squire, Halverson, & Gee, 2005; Squire, 2006; Steinkuehler, 2006). The power of these technologies reflects not industrial-age efficiency but twenty-first-century opportunity: They provide entire worlds designed to help learners adopt roles and engage story lines previously inaccessible to them. If properly designed, they can provide the problems, tools, people, experiences, perspectives, and consequences to ensure that learners develop rich content understanding (Barab, Gresalfi, & Arici, 2009).

In this article, we discuss our game research and design work of the past decade, centered on the educationally based,

multiplayer online videogame called Quest Atlantis, for which we were lead designers.¹ This work has given rise to the belief that videogames are a powerful medium in which curriculum designers can create new worlds that invite youth to become scientists, doctors, writers, mathematicians, and the like. In these roles, players develop and apply increasingly sophisticated academic understandings as they change the conditions of the content to transform both the virtual world and their ability to take on more complex problems. It is in this way that videogames can be used to position person, content, and context in transformative ways. This sort of consequential engagement is very difficult to accomplish in schools and in noninteractive media; teachers can describe a situation, share a book, or even show a movie, but doing so does not create a setting that learners can act upon (and change) in personally valued and socially significant ways. In contrast, in a game world we can support such interactions and design them to push back and evolve players' understandings of academic concepts. This is, in part, because when playing a videogame the players are granted a form of *dramatic agency*: They make decisions that affect the direction of an unfolding story line central to the fictional game context (Murray, 1997).

We believe that the opportunity to have a personal, agentic, and consequential role in resolving a dilemma is a significant component of both content learning and potentially more enduring outcomes, such as the development of identity or affiliation (Donath, 1998; Turkle, 1995). The plausibility of this positioning is made possible because of the fictional nature of the game world in which such consequential positioning of the player is reasonable if not expected (Gee, 2003; Squire, 2006). Thus narrative videogames can become transactive curricula that afford dynamic interplay between player and story line, between knower and known, between action and understanding (Barab, Dodge, et al., 2010). And, of central importance to educators, the freedom afforded by the fiction allows the designer to take pedagogical liberties to ensure that educational lessons are experienced; for example, allowing players to travel into the future to see the impact of their actions. Thus a player can become the protagonist who determines, within designed parameters, how the story unfolds. It is in this way, we argue, that games are transactive, enlisting narrative story lines and interactive rule sets that support a dynamic (transactional) unity of person, content, and context in which all are transformed through participation.

Although fiction more generally can afford engagement, perspective taking, and projective identification with plotlines that

potentially resonate with other situations (cf. the notion of “metaphorical loft” in Bruner, 2002), we argue that videogames—with narratives that are *playable*—have the additional potential to position players to experience a sense of agency and consequentiality (Gee, 2003). Realistically, students rarely have the opportunity or the ability to solve a real-world water-quality problem or to write a persuasive article to determine the direction of a community decision. Yet in the sheltered story line of a fictional videogame world, we can create this opportunity and make the role and its significance quite believable. Because the player is driving the unfolding story line, it becomes, in a very real way, the player’s own story. Moreover, in a game, failure is tolerated and risk taking is encouraged; players can experiment with conceptual understandings and learn from the impact of unproductive choices. So, for example, misapplying one’s understanding of eutrophication could result in a substandard game choice about a fictional water-quality problem resulting in negative conditions for a virtual park. However, this choice is not terminal; it can be reflected on and ameliorated to promote deep engagement with the content and even drive new learning opportunities.

In the next section we advance the theory of *transformational play*, grounded in the ideas expressed above and in our previous research. We then present illuminative cases from our own work that demonstrate the value of the theory for informing instructional design.

Transformational Play

Our theory of transformational play is an extension of Dewey’s (1938/1963) idea of *transactivity*: that “every experience enacted and undergone modifies the one who acts and undergoes. . . . For it is a somewhat different person who enters into them” (p. 35). However, as Dewey further noted, “every genuine experience has an active side which changes in some degree the . . . conditions under which experiences are had” (p. 39). The idea of transformational play draws upon the epistemological position that both knower and known constitute, and are constituted through, meaningful inquiry (Connell, 1996; Dewey, 1938/1963; Dewey & Bentley, 1949). Such a transactive view, as it relates to designing game-based curricula, requires not only recognizing the interrelations between the ways that person and situation can change one another, but also intentionally leveraging that realization to design for more powerful learning experiences. Thus our designs build on a theory of learning that assumes that learners, content, and context are inextricably bound together; our designs therefore position learners as active decision makers who use their understandings to inquire into particular circumstances and change them.

Building on related work that connects person, content, and context (Brown, Collins, & Duguid, 1989; Cognition and Technology Group at Vanderbilt, 1990, 1993; Greeno & Middle School Mathematics Through Applications Project Group, 1998; Lave, 1991; Wenger, 1998), we have developed a theory of transformational play to account for the experiences that we wish to foster through our designs and the elements to which we must attend in creating new curricula and play spaces (Barab, Gresalfi, & Arici, 2009). Merely playing a game does not ensure that one is engaged in transformational play. Playing transformationally involves (a) taking on the role of a protagonist (b) who must employ conceptual understandings (c) to make choices (d) that have the potential to transform (e) a problem-based fictional

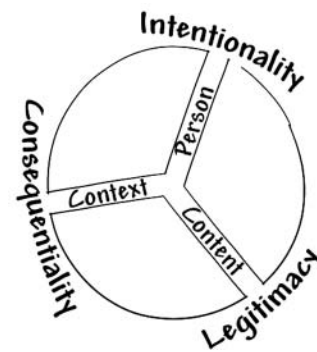


FIGURE 1. *The core elements of transformational play (spokes of wheel) and the target types of positioning for each element.*

context and ultimately (f) the player’s understanding of the content as well as of (g) herself as someone who has used academic content to address a socially significant problem. Playing transformationally integrates person, content, and context as part of a transactive system in which each type of positioning motivates and is motivated by the other types (see Figure 1). Such a functional unity is central to meaningful participation outside of schools and is central to why being a scientist or a reporter is often so compelling to those who choose those careers.

Problematically, however, these functional relations are often cleaved in formal learning contexts such as K–12 classrooms, where, for example, what it means to be a scientist, what it means to use science, and what it means to know science are very different things (Barab, Sadler, Heiselt, Hickey, & Zuiker, 2007; Barab, Zuiker, et al., 2007; Roth, 1996). Acknowledging this problem, Lave (1997) commented that it appears that the “academic and educational establishments are caught in a serious dilemma concerning the role of distance from experience in strengthening and at the same time weakening learning” (p. 28). Learning is weakened in part because it remains difficult to appreciate the meaning of content when separated from contexts of application, but also because learning is treated as something that happens *to* the learner and not as an intentional process that becomes more powerful when engaged *by* the learner in the service of resolving a significant problem. In contrast, we argue for a model of participation that involves intentionally leveraging the three interconnected elements of *person*, *content*, and *context*. Specifically, when creating spaces to afford transformational play, we attempt to create experiences that position these elements 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)

Each of these forms of positioning is briefly elaborated here and then further illustrated through two illuminative cases in the following section.

Person With Intentionality

When a context supports acting with intention, it creates a reason for being there (motivation), and helps to shape players' attention to both the story and the conceptual tools that would be required to successfully engage the story. One of the most powerful opportunities offered by games is that players are not just observers but are often protagonists who make decisions that affect the game world and reveal personal biases and misunderstandings. Thus games can offer to players the experience of "playing out one's self" (Gadamer, 1975, p. 132). The players are changed both through dialogue with interactive game characters that they encounter subsequent to their decisions and through their reflections on themselves as the types of players who have made such decisions (Barab, Dodge, Ingram-Goble, et al., 2010). In this way, videogames can allow students to try out new ways of being through the appropriation of and projection into the external agent (avatar), which they can safely try on and act through, in ways unlike what might be recognized as possible in their "real" world. Gee (2003) discusses how players, when playing a game, do not experience the play as their normal self, or simply as an external avatar manifesting a novel self, but rather as their virtual projective self—part real, part avatar. It is in this dynamic between their choices and the game's possibilities that the players begin to see the world, and their opportunities to act upon it, as different or revised. Such positioning, especially when the narrative consequences of players' choices are intentionally designed to highlight an important tension of the discipline, is a significant affordance of games for education. And, ironically, although this fantastical space exists only in bits and bytes and in the imaginations of those who enter it, it is only in the fantasy space that the notion that a primary school student can be a reporter, a scientist, a historian, or even a superhero is quite believable (Bateson, 1972/2000).

Content With Legitimacy

Disciplinary content knowledge is a valuable tool that can be used to change the world. Unfortunately, leveraging content knowledge to solve problems is an endeavor often reserved for adults; when children learn new information, it is frequently presented in the form of disconnected, external facts. Contexts that position learners as mere spectators whose role is to remember static knowledge may not capitalize on the possibilities for supporting meaningful understanding. Furthermore, in a context focused on acquiring information and reproducing objective understanding, accountability and authority lie external to the learner and thereby undermine the learning process (Gresalfi, Martin, Hand, & Greeno, 2008). In contrast, games can provide a framing that legitimizes the participation of the players by establishing a value system for both the context and the players' actions that honors their agency and the need for mastering content if they are to resolve a problematic situation—one that has been designed to be pedagogically illuminative, in that solving it requires applying disciplinary understandings.

More than following a series of procedural steps, games provide players the opportunity to determine when to use particular content; and they provide the experience (as well as motivation) that players need to critically analyze the consequences of their

actions in conceptually revealing ways. These different opportunities prompted Gresalfi, Barab, Siyahhan, and Christensen (2009) to contrast four types of content engagement: procedural, conceptual, consequential, and critical. A core goal of transformational play is to support these four types of content engagement, as students are encouraged to engage not only procedurally with content (learning about what to do) but also conceptually (understanding how their tools work), consequentially (considering the impact of their actions on designed contexts), and critically (reflecting on the effectiveness of particular tools for accomplishing desired ends). Of particular interest is the use of games as learning tools to support consequential understandings: In the game world, insufficient understandings result in uninformed actions that fail to achieve an appropriate impact. And through an examination of the game consequences, students are able to engage the content critically as they question its meaning in situ.

Context With Consequentiality

An essential aspect of conceptual game play is that individuals are experientially situated within a space where they have a legitimate role and their actions have effects on a particular context. Thus context is not an external referent enlisted by the teacher to give the lesson meaning, nor is it a future place where the content will someday be relevant. It is an actionable context that is resonant with and responsive to learner actions. Such *experiential consequentiality* is quite a contrast to the *arbitrary consequentiality* of exchanging work for grades, as typically is found in American schools. Likewise, experiential consequentiality elevates the *projective consequentiality* that has been so important to problem-based learning curricula and other designs that are intended to "situate" or "contextualize" content understanding but that occur in contexts that do not respond to learner actions (Cognition and Technology Group at Vanderbilt, 1993). This consequential feedback is an important learning tool, for rather than having to hypothesize about the implications of their actions (a process whose ultimate accountability is tied up with the teacher, an external authority), students are able to experience the impact of their actions, and the impact becomes authentic feedback about their initial assumptions and understandings. In this way, games become an interactive context for helping children to experience the use-value of content and, more important, to experiment with different applications of that content in which failure is a legitimate opportunity to learn. Beyond providing a dramatic story line to contextualize the meaning of the concepts, the designer can program the game mechanics to enable children to play with the concepts as they act within the game, for example, as they add pieces of limestone to change the pH level of water.

Illuminative Cases

From a design perspective, facilitating transformational play requires creating spaces that are responsive to players' decisions, such that both the game and the player change as game play progresses (Barab, Gresalfi, Dodge, & Ingram-Goble, 2010). Designing for these interactive trajectories requires careful attention to the interplay between person, content, and context. In the next section, we further unpack these elements of transformational

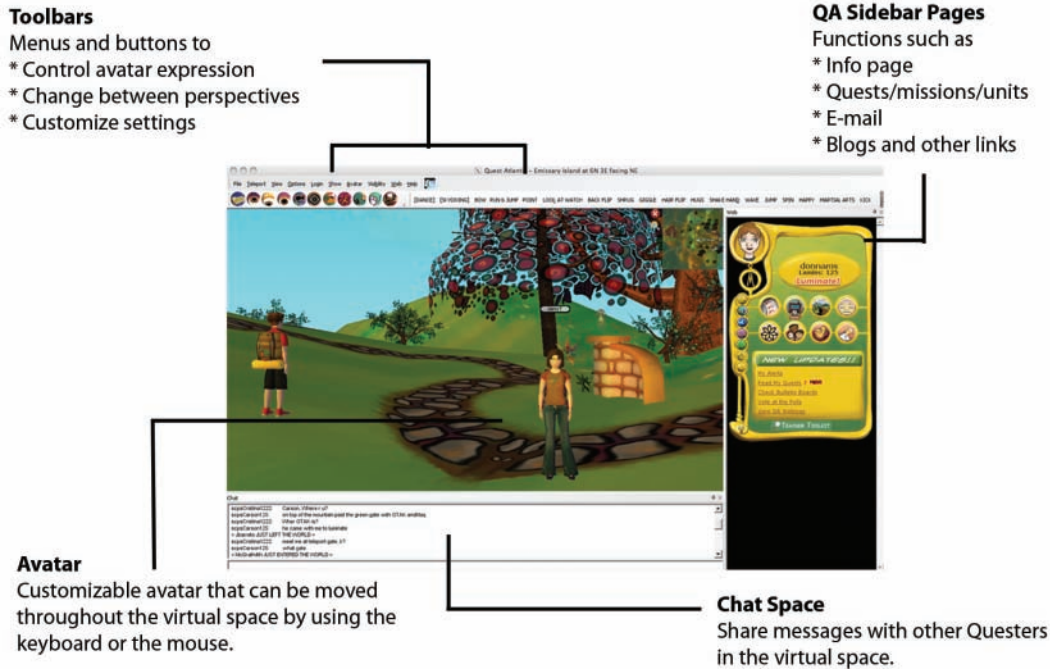


FIGURE 2. *Screen shot from the Quest Atlantis Gaming Project. The left side shows the 3D world, which can include multiple avatars controlled by different players, and the right side shows the player's home page.*

play by presenting two units in Quest Atlantis (QA; see <http://QuestAtlantis.org>). As is elaborated elsewhere (Barab, Dodge, Thomas, Jackson, & Tuzun, 2007; Barab, Gresalfi, & Arici, 2009; Barab, Thomas, Dodge, & Cardeaux, 2004; Barab, Zuiker, et al., 2007), QA is a learning and teaching project that uses a 3D multiuser environment to immerse children, ages 9–12, in educational tasks. Building on the model of online role-playing games, QA combines strategies used in the commercial gaming environment with lessons from education research on learning and motivation. The core elements are (a) a 3D multiuser virtual environment (MUVE) (see Figure 2); (b) an unfolding story line involving a mythical Council and a set of social commitments; (c) a customizable home page and various professions through which a player's character can evolve; (d) inquiry learning activities presented as quests and missions (as in the two example units presented later); and (e) a globally distributed community of more than 50,000² participants from multiple countries who interact with each other within the game world and outside the game world if they are in the same classroom.

Using their avatars, students navigate through the virtual park and interact with other players and in-game characters, who use pre-scripted dialogues to communicate their perspectives on particular issues. Much of the game play takes place as players click on nonplayer characters that have been scripted to respond in ways that are consistent with the game narrative and which change on the basis of previous player choices and in-game happenings. So, for example, if the player initiated a logging ban, logger characters in the game would become aggressive in their response to the player. As students complete various activities, their game characters also change in both appearance and functionality (i.e., their game characters can perform previously inaccessible behaviors). Even within the constraints of the many activities

assigned by the teacher, players can evolve their characters on the basis of personal interests and priorities, such that, over time, they rarely have similar game experiences or character profiles.

With the goal of further grounding the theoretical ideas discussed here, we now present two curricular units of QA that have inspired multiple research publications, demonstrated statistically significant learning gains, and collectively been used by more than 15,000 children worldwide (Arici, 2009; Barab, Dodge, et al., 2010; Barab, Sadler, et al., 2007; Barab, Scott, et al., 2009; Barab, Zuiker, et al., 2007; Hickey, Ingram-Goble, & Jameson, 2009).

Example 1: The Taiga Fishkill

The Taiga Fishkill unit is an interactive narrative set within an aquatic habitat (Taiga National Park), where a serious ecological problem has resulted in a significant decline in the fish population (Barab, Sadler, et al., 2007; Barab, Zuiker, et al., 2007). Students are hired as environmental scientists whose job is to investigate the fish population decline and propose solutions to the problem. To prepare the students for this role, the curriculum begins with an overworked scientist, Abby, asking the visiting players to make several observations of and corrections to the conditions of fish tanks she is using to run some experiments (see Figure 3). Players find that the dissolved oxygen in one tank is low, causing the fish to breathe near the surface, and in another tank they observe that a significantly acidic pH has killed some fish. As they are scaffolded through a process of resolving each tank's problems, Abby becomes impressed by their growing sophistication in analyzing and solving the problems and recommends that they be hired to solve the fish decline problem at the local national park, where Abby once worked. In this way, the content that students are asked to leverage is positioned as legitimate for resolving the dilemma faced by the park.

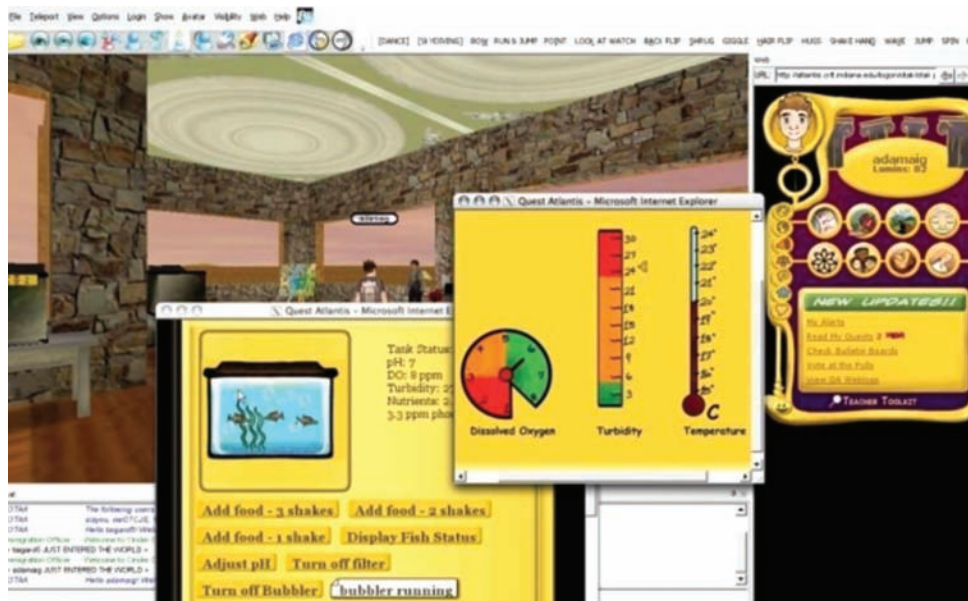


FIGURE 3. Screen shot from the *Taiga Fishkill* unit showing a pop-up sequence associated with the fish tank, and a player home page at right.

The consequentiality of the context is supported by creating key decision points that require leveraging of disciplinary formalisms and enable players to observe and interrogate the consequences of those decisions. For example, in investigating the problem, students are introduced to concepts such as erosion, eutrophication, water quality, and system dynamics. As they are introduced to what these concepts *mean*, they experience *how* the concepts *have meaning* by making decisions about how to improve water quality. Students, for example, may decide to target the role of nitrates in the water by asking the indigenous tribes, who are farming near the water, to stop their activity; they might focus on the role of erosion by asking the loggers to leave the area, or they might attribute the fish deaths to overfishing and ask the commercial fishing company to close. After making such decisions, students are able to see and consider the consequences of their recommendations by traveling to a future world. In this way, they can reflect on the consequentiality of various disciplinary constructs, and in the process they work with skills such as graph construction and deconstruction, hypothesis generation, water-quality analysis, socioscientific reasoning, and scientific inquiry.

Students are encouraged to act with intentionality by being positioned as expert helpers who can have an impact on the situation by determining the causes for the drop in the fish population. From the beginning, with the fish tanks, the players are able to address water-quality problems through simple actions such as turning on a bubbler or modifying the pH by adding a basic solution to the tank. Then, on the basis of their successes or reflective failures with these tasks, the players are asked to carry out various investigations into the health of the waterway and the effects of nearby park activities—and nonplayer characters treat them as if they have the skills and dispositions to succeed. More specifically, the players interview people with various perspectives on the problem, collect and analyze data to develop a hypothesis about the problem, propose an informed and practical solution, and examine the impact of their recommendations—all practices designed to position them in the role of scientist. Because there

is no clear right answer, students have to find a balance between what the data are telling them about the river, their values with regard to the park community, and their personal sympathies, which may lie with some community groups over others.

To further illuminate the power of transformational play, we now offer an example of an interview with a fifth-grade boy, quoted from Barab, Sadler, et al. (2007), which illustrates the extent to which students are immersed in the game play and how they come to treat fictional characters as if they were real:

I have a question: Why aren't the people just coming clean? Why aren't they saying "I think I did this because we've been doing this" or something? 'Cause they aren't really saying what they're doing or coming to the park or—they're not coming to the rangers saying "Can we have a meeting so everyone can say what they've done?" I mean, it seems like if you wanted to help the park and you wanted to still use it, the rangers would be more happy if you told them what you were doing now and try and change your ways instead of keeping going 'cause you'd probably get kicked out of the park if you don't tell them now. You're probably gonna ruin the fish population. And it's gonna take them at least probably two years to at least get it back to normal. (p. 64)

What is important to highlight in this excerpt is that students are sufficiently immersed in the story line to be affectively engaged and demand accountability from the characters as if they were real people. What's more, this student, with his feeling of indignation about the behavior of the characters, appears to see himself as having a central role in the emerging story. When students are situated in this way, they have a reason to leverage disciplinary content, exercising intentionality on what they clearly see to be a legitimate dilemma. And, more important, they see their role not simply as understanding academic content but as having an impact on the world.

The next example illuminates how positioning the science content in the context of the playable fiction changed the task of reading and interpreting an inscription (in this case, a diagram) from an act

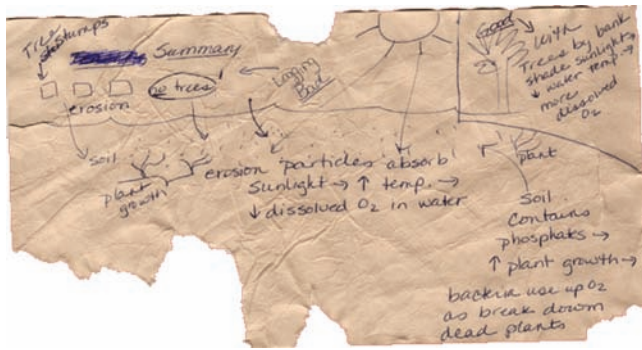


FIGURE 4. Diagram of the process of eutrophication, adapted from a science textbook. It was drawn informally, dipped in wet coffee grounds for photographing, and incorporated in the Taiga Fishkill unit as a fragment of a “scroll” to be found by students.

of compliance to a legitimate effort at interpretation and understanding. It also demonstrates how the play and meaning making that begin in the virtual environment extend into the real world as students have conversations about their game play. In the observed face-to-face exchanges that follow, students in the same fifth-grade classroom discover in game a scroll fragment with a hand-drawn representation of the process of eutrophication, and they are trying to interpret its meaning (see Figure 4).

Girl1: Look at the top. There’s a little hint. It says ‘No trees cut down. Bad’, so it must be the loggers that wrote that—

Girl2: No, no, no. It doesn’t say ‘No trees cut down’. I just figured it out ‘cause I just changed it and I thought it said that too. Then I found that ‘No trees bad’ means there are not trees, so it probably isn’t the loggers and the loggers would think it was good that there was no trees ‘cause then they’d have logs.

Girl1: But they wouldn’t have anything more to cut down.

Boy: But still, they do replant trees once in a while.

Girl2: But the thing up there says ‘Trees by the bank, shade, sunlight, water, temp, more dissolved oxygen’.

Boy: There are things about the particles absorbing sunlight; it sort of proves that the Mulu are not guilty because their temperatures were actually really low, and so that means they had trees too. And the loggers probably are able to cut in the place where the K-fly fish. So I think it’s the loggers and sort of the K-fly fishers combined and not the Mulu, because the Mulu, first of all, they have trees because they’re off the park and not in it, and also, they don’t really have much stuff; their turbidity was good, so . . . (Barab, Sadler, et al., 2007, p. 69)

In this exchange, the to-be-learned content (i.e., that the diagram explicates the process of eutrophication) appears to be both significant and meaningful to these students because of its relevance to their intention to determine why fish are dying in the park. It is in this way that having an intention legitimizes the value of understanding erosion and drives the act of interpretation, an outcome that influences players’ decisions about which stakeholder to blame and their understanding of the subsequent world changes resulting from their recommendations.

As further empirical validation of the curriculum’s value, in one 2-week comparison study with average sixth graders, we

examined the differences between learning science content on water quality in a traditional science classroom with a traditional curriculum and learning the same disciplinary content embedded in QA (Arici, 2009). The traditional curriculum was text based, and activities were teacher led; in the QA condition, the curriculum was virtual, and students uncovered information within the virtual world while the teacher provided support. There were two classrooms in each condition, all taught by the same seventh-grade teacher in a rural community. Lessons in the traditional condition involved lecture, class discussion, and carefully organized notes, with microcontexts serving as examples (a new exemplar for each new concept taught, as is typically found in textbooks). Lessons in the QA condition were embedded in the story of Taiga, and all science content was distributed in the game, needing to be uncovered and solved, within the overarching narrative about fish decline.

The pretest of standardized science test items showed no significant differences between conditions, $t(91) = .16, p = .87$, or between the four classes, $F(3, 89) = 1.09, p = .36$, indicating equivalent ability with respect to understanding of water-quality concepts. The posttest showed significant learning gains for both conditions, indicating that both groups learned about water-quality concepts. But the QA group learned significantly more than the traditional group, as indicated by a repeated measures ANOVA, $F(1, 115) = 6.53, p < .01$. Specifically, the QA students were able to more accurately interpret data presented as multiple-choice test items, define core concepts such as erosion and eutrophication, and, as part of a transfer task, analyze a fictional stream in which they had to identify a problem that involved systems-level understandings. In addition, the delayed posttest, administered after 8 weeks, showed the students in the QA condition ($M = 23.65, SD = 5.85$) scoring significantly higher than the students in the traditional classroom ($M = 18.4, SD = 6.52$) on a series of multiple-choice and short-answer items testing their understanding of water quality as applied to a novel scenario, $t(91) = 4.02, p < .001$. These results show that the QA group had a deeper understanding and significantly less forgetting over 2 months following the intervention.

Furthermore, when asked why they were doing this task, 97% of the traditional students said it was because they were required to (65% selected “to get a good grade” and 32% selected “the teacher told me to”). In contrast, only 36% of the QA students selected those reasons; 46% indicated that they were doing the task because they “wanted to be doing it,” and 18% gave other reasons not having to do with being required to do it. This contrast was significantly different from chance, $\chi^2 = 24.87, p < .001$. In addition, 91% of the students in the QA group logged in after school, and 75% completed extra-credit assignments, whereas only 2 students in the control group completed such activities. In summary, we found that students who used QA, more than students in a traditional classroom, were motivated by a developing interest in the curricular content and an enjoyment of the learning experience rather than by a sense of obligation or concern about a grade.

Example 2: Modern Prometheus

The unit Modern Prometheus was developed with the goal of better understanding the potential of converting a classic piece of

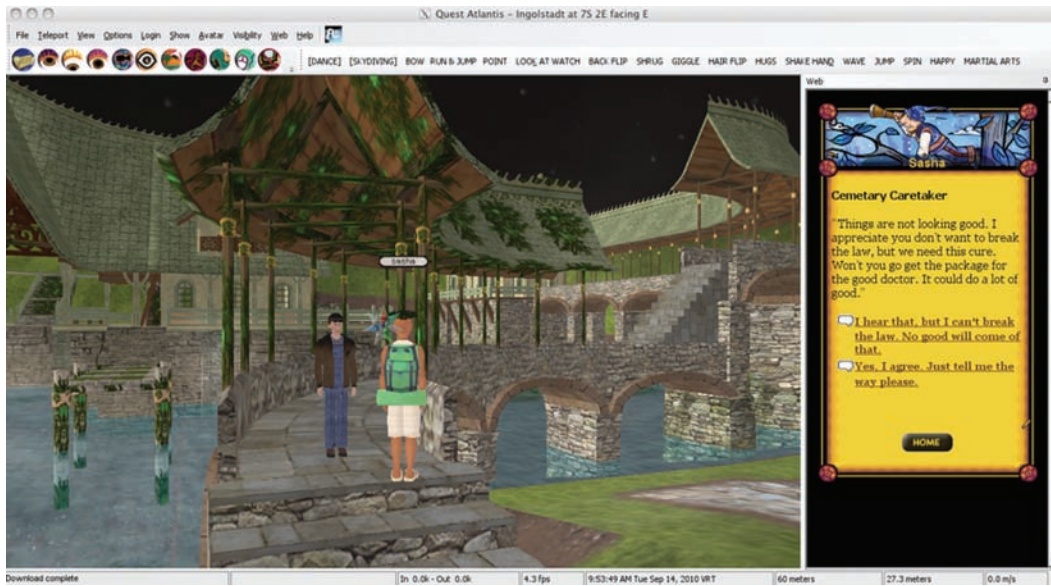


FIGURE 5. Screen shot from the *Modern Prometheus* unit showing a darker context. The player walks toward a graveyard, where she may choose to steal body parts to help the doctor.

literature, such as Mary Shelley’s *Frankenstein*, into a transformational play space (see Figure 5; Barab, Dodge, Ingram-Goble, et al., 2010). *Modern Prometheus* focuses on persuasive writing, as students are asked to convince others to share their perspective on particular ethical dilemmas. In particular, students grapple with the role that ethics play in science and technology; in this case they consider whether and when ends justify means in a battle with a bacterial plague, as well as the notion of companionship. The game culminates with students’ making a decision about whether Doctor Frank’s creation is “human” and trying to persuade others of their views on whether “it” should be used for experimentation.

To support *intentionality*, players initially receive a letter from their fictional mothers, pleading with them to visit Doctor Frank and assist him with “anything he needs.” (In the first version of the game, the reason given by the mothers was that their children were compassionate people; in the current version, to better highlight the conceptual skills to be learned, the mothers’ reason is the children’s skills as investigative reporters.) Stepping off the train as they arrive in the plagued town, the players make their way through the town square, meeting each of the major townspeople and gaining a sense of the general desperation regarding the plague. They speak with people who have lost family members and friends. This establishes the players as insiders to the story and more generally as citizens needing to care for the well-being of others. Players are positioned in an important role, working as writers who engage and develop persuasive writing skills. They have to reflect on the happenings in the town and on their own beliefs, and then use both evidence and their own opinions to craft an argument supporting or opposing the doctor’s experiments. They aim to convince even the most committed dissenters.

Experiential consequentiality is threaded throughout the unit. For example, very quickly after making their way to the doctor’s lab, players engage the first ethical dilemma of the unit: They decide whether to steal a mysterious package from a crypt in the cemetery, a task that will involve lying to the constable

afterwards. It is in this moment that they experience their first sense of consequentiality with the philosophical notion of ends justifying means. Given the choice they make at this point, they begin to develop a stronger reputation either with the doctor or with the constable. Further emphasizing the significance of these different reputations, in the last of the five missions players experience a visually different world based on the decisions they make (e.g., a world where a chained-up creature is experimented on, or a world that has been overrun by the plague but where the creature has a safe home).

The core focus of student activity is to produce a persuasive essay that the editor of the town newspaper will publish and that will convince others to take up the student’s recommendation (either allowing the doctor to continue with his experiments or stopping him because they are considered unethical). In the role of persuasive reporter, players navigate around the 3D world, interacting with game-based characters and collecting quotes either supporting or refuting their theses (that the doctor should or should not continue with his experiments). Then the players assemble the quotes, choose a thesis, and receive a score based on the quotes’ relevance to their choice (see Table 1). In this way, the content that students engage—persuasive writing—is positioned as a legitimate set of tools that can be used to influence the world. In addition, on the basis of the evidence that they collect and the arguments they advance as they begin to write for the newspaper, students develop a reputation, which is recognized by characters in the space, who refer to the players’ skills and accomplishments—further supporting their sense of dramatic agency in the unfolding story line.

As an example of the ways that our designed positioning of person with intentionality and consequentiality has been taken up, we offer here an excerpt from an in-game letter submitted by a student who had argued that the creature be allowed to live (thus preventing the creation of a cure for the plague). Having observed the consequences of her choice in the world, the student feels uncomfortable and writes to the fictional town mayor that

Table 1
Value Association for Two Sample Dialogue Pages From Modern Prometheus:
Assigning Point Values to Supporting Evidence in the Plague Debate

| Collected Quotes | Pro Argument and Reasons | | | Con Argument and Reasons | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------------------|
| | The doctor should be allowed to continue searching for a cure for the plague, using his “subject” in medical experiments. | | | The created creature should be set free, and the doctor should stop his experiments to find a cure for the plague. | | |
| | Ends justify means. | The doctor is not harming citizens. | The creation will not be missed. | The doctor has no right to abuse the creation. | Ends do not justify means. | The doctor should not be trusted. |
| “As you know, as mayor my loyalties will always lie with what is best for my village. And not only that, this <i>cure will help all of society, not just Ingolstadt</i> [italics added]” (P1). | 3 | 1 | 0 | 0 | 0 | 0 |
| “ <i>The doctor is dangerously obsessed with finding a cure</i> [italics added]—it’s all he cares about. And when someone’s that obsessed, he’s a danger to everyone around him” (C5). | 0 | 0 | 0 | 3 | 3 | 3 |

Note. P1 = “pro” quote No. 1; C5 = “con” quote No. 5. The numbers in the table show the scores the player earns for aligning the particular quote with the particular reason.

she no longer sees herself as a good decision-maker for the town. She writes:

I am sure that all the villagers people will die if Frank does not keep working on his antidote. It now seems that the antidote will no longer work the plafue [plague] is spreading faster and faster by the minute. *I will be best for the people of Ingolstadt to no longer accept me as a fellow helper of the village* [italics added]. If the doc continues his work he may be able to help maybe.

This comment suggests that the student sees herself and her decisions as having a significant impact on the world—in this case an impact which she did not foresee and which she does not like. In her reflections, she reveals both her own role in shaping the outcome for the town and how she feels her particular decision ultimately failed the town. Thus it is clear that this student has taken up the opportunity to act with intentionality and now, on the basis of the consequences of her actions, is reconsidering her original decision.

Important to note, this narrative is bound up as part of a curriculum intended to support persuasive writing, which is used as a legitimate tool for enacting change in the designed context. A final portion of a student’s final essay, excerpted from her game submission, is included here to further illuminate content positioning:

The creation has fought for his rights but has never been given a chance because of his looks. The creation is not an animal or a monster. Humans are set apart from other creatures by their ability to think and reason. In arguing for his rights (as well as making friends and being able to read) the creation shows that he can do these things. . . . The creation has human emotions and empathy. He felt sympathy for a boy and his father who were struggling financially and gave them aid by bring food to their home. He also told me that the doctors experiments and treatment of him

hurt his feelings. . . . In addition to that, the doctor has no right to be experimenting on the creation. His experiment is unauthorized and therefore, illegal! Scientists must have permission to do experiments.

Here, we see evidence of how the student took quotes collected during game play to produce a persuasive essay that offers arguments with evidentiary support. The skill of persuasive writing is enlisted in the service of a personally meaningful and socially important goal—one that can be created, adopted, and realized all in the context of six classroom visits to a computer laboratory located in a school building.

In a comparison study, high-need seventh-grade classes in an inner-city school in North Carolina were assigned either the game treatment or an equivalent control curriculum taught by the same teacher (Barab, Pettyjohn, Gresalfi, Volk, & Solomou, 2010). The control class went through a persuasive-writing unit based on the novel *The Clay Marble*, which had been assigned to the class. Students in the control group spent the first 45 minutes of the day (Period 1) listening to an audio recording of the book while they read or followed along in their books. The assignments were a mix of reading comprehension and persuasive writing. Results showed significant learning gains for the control group, $t(31) = 8.75, p < .001$, from pretest ($M = 7.16, SD = 3.72$) to posttest ($M = 11.22, SD = 4.98$), as well as for the experimental group, $t(32) = 14.85, p < .001$, from pretest ($M = 8.55, SD = 3.77$) to posttest ($M = 14.67, SD = 3.52$) in terms of their ability to identify important parts of a persuasive argument and to write a persuasive essay in response to a writing prompt. Both groups had large effect size gains (control = 1.22, experimental = 1.83), as would be expected from a 2-week lesson with an experienced teacher. However, the repeated measures showed significantly greater learning gains for the QA condition when

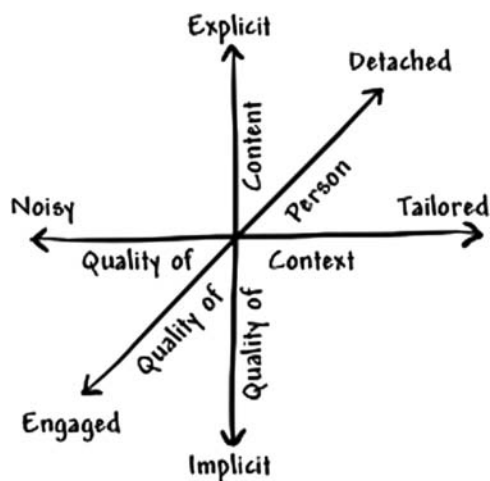


FIGURE 6. *Tensions in designing learning environments for schools that use transformational play.*

the two groups' persuasive essays were compared for quality, $F(32, 31) = 11.03, p < .001$.

In addition, students who were assigned to the treatment condition reported significantly higher levels of engagement, had different goals motivating their participation, and received fewer teacher reprimands to stay on task. The children in the two conditions showed significant differences in level of engagement: The treatment condition ($M = 4.16, SD = .55$) scored almost 2 standard deviations higher than the control condition ($M = 3.24, SD = .59$), indicating significantly higher levels of engagement, $t(35) = 7.61, p < .001$. Closer examination at the item level revealed that 86% of students in the experimental group enjoyed or strongly enjoyed the activity, as compared with only 22% in the control group. Also, when asked if they wished they were doing something else, 71% of the experimental group chose "not at all," whereas 70% of the control said "definitely." Last, when asked about their main reason for completing the activity, 95% of the control students said they wanted to get a good grade or that their teacher required the activity. In contrast, only 34% in the experimental condition indicated that these were their reasons for doing the activity; 65% said that they did it because they wanted to be doing it.

Challenges, Opportunities, and Evidence

Designing experiences to support personal engagement and transformation requires balancing a number of tensions. In a 2006 article, Barab and Roth discussed the tensions between providing a contextually rich curricular environment and ensuring that learners attend to the particular content that the environment is designed to teach. In particular, Barab and Roth argued that it is a balancing process in terms of the *quality of content* (*explicit versus implicit*) and the *quality of context* (*noisy versus tailored*)—to which this article adds a third aspect, *quality of person* (*detached versus engaged*); see Figure 6. Noisy contexts containing rich contextual detail and mostly implicit enlistment of disciplinary content can foster mystery, realness, discovery, and an appreciation of why the content matters. Alternatively, an emphasis on tailored contexts with explicit enlistment of disciplinary content can prove efficient, making particular concepts salient, and can

be more straightforward for teaching in larger classrooms. Regarding person, a sense of detachment from the story can allow for more objective analysis and reflection, although it may also breed apathy and disengagement from the lesson. In other words, we argue that if the curriculum focuses too much on explicit content in a context tightly tailored to that content, and if students have no embedded role, their experience may become impoverished, with a focus on memorization and grade attainment as opposed to meaningful content application.

If the goal is to aid students in appreciating academic content as useful and seeing themselves as people who have used such content to address socially significant and personally meaningful problems, then the learning environment needs to shift toward the bottom left of the diagram pictured in Figure 6. Therefore, designing to support pedagogically useful transformational play involves balancing tensions across each element (person, context, content). We struggle with these tensions in our designs as we try to avoid overly privileging any one quadrant of the diagram (see Barab, Gresalfi, Dodge, & Ingram-Goble, 2010). Building on the work of Hickey and colleagues (Hickey, Ingram-Goble, & Jameson, 2009; Hickey & Zuiker, 2005), all of our designs pass through multiple iterations in which they are revised until they achieve the desired outcomes at three levels of assessment: the *close* level (referring to log files and in-game submissions), the *proximal* level (referring to performance and classroom assessments), and the *distal* level (referring to the use of external developmental achievement test items). Each level is positioned along a continuum defined by increasing generality and/or abstraction from the enactment of specific curricular activities (cf. Snow, 1974). Based on analysis of the data, design changes are made to improve and enhance players' experience and learning. The close-level, activity-oriented outcomes include whether the curriculum functioned as intended in terms of task structure and game play dynamics (i.e., the data include log files of game play choices and field notes), whether students were engaged in the story line (i.e., the data include interviews, surveys, and evidence of after-school play), and whether in-game submissions provide evidence that academic concepts were leveraged (i.e., the data include in-game tests, whole-class discussions, and submitted essays). The proximal-level, curriculum-oriented outcomes include teacher-created tests designed to test learning of the core concepts as well as assessments consisting of cherry-picked released test items. The distal-level, standards-oriented outcomes involve primarily far-transfer assessment consisting of standardized items drawn at random from larger pools of items aligned to the targeted standards as well as other external measures not intentionally designed to test the particular unit. In designing game spaces, we begin by looking at close and proximal data, and only once we are getting consistent high-level performance on these do we test at the distal level—assuming there are standards-based items created for the content area (Barab, Zuiker, et al., 2007; Hickey et al., 2009).

A challenge inherent to this work is how to conduct research that is intended to simultaneously demonstrate the value of a particular design and advance theory about why the design works. At one level, we are interested in demonstrating the feasibility and efficacy of the work. Evidence that the project in general has been successful can be seen in the numbers of students and teachers who use the game with no incentive beyond the

learning outcomes that students experience; these units have been used by more than 50,000 children from a wide range of socioeconomic backgrounds in school districts all across the United States and in Australia, Brazil, Canada, China, Croatia, England, Italy, Japan, New Zealand, Singapore, South Africa, and Turkey. We have also conducted numerous studies that demonstrate statistically significant learning gains, even on standardized tests, as well as high levels of engagement when teachers and students use our designs in the classroom (Arici, 2009; Barab, Dodge, et al., 2010; Barab, Sadler, et al., 2007; Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005; Barab, Zuiker, et al., 2007; Hickey et al., 2009; Warren, Dondlinger, & Barab, 2008). However, our goal is not simply to validate a particular curriculum. Although demonstrating impact is potentially necessary, it is certainly not sufficient if one's goal is to build new theories about how people learn.

Toward evolving new theory, we have found ourselves drawn to the idea of design experiments (Brown, 1992), also known as design-based research (Barab & Squire, 2004). Cobb, Confrey, diSessa, Lehrer, and Schauble (2003) describe them this way:

Prototypically, design experiments entail both “engineering” particular forms of learning and systematically studying those forms of learning within the context defined by the means of supporting them. This designed context is subject to test and revision, and the successive iterations that result play a role similar to that of systematic variation in experiment. (p. 9)

Central to design-based research is a commitment to move beyond understanding learning as it naturally occurs, toward designing interventions that perturb existing contexts in useful ways with the broader goal of using these theoretically inspired perturbations as a means of warranting new theories. Although justifying such a methodological approach is beyond the scope of this article (see a rich discussion in the January/February 2003 theme issue of *Educational Researcher*), the important point is that advances in design technologies from the entertainment sector are creating opportunities for learning that introduce new experiential states, such as transformational play, which are difficult to manifest without engineering new opportunities and then demonstrating their relevance within naturalistic contexts. It is in this way that our work transcends what exists currently and instead helps manifest what could be (Barab & Squire, 2004). These powerful technologies can also be used to enhance the ways that these theories are communicated to the world. This is because rather than simply using printed text and accompanying images (as in this article), these technologies involve new forms of representation that are quite illustrative, especially when introducing an audience to a new phenomenon (Gee, 2010).

Worked examples, as discussed by Barab, Dodge, and Gee (2009), provide an important form of scholarship especially relevant to illustrating plausibility claims for emerging theories. In their description, “worked examples can be thought of as making plausibility arguments and offering illuminative proof-of-concept instantiations with a focus on revealing mechanism and process to afford insight, promote dialogue, and inspire change” (p. 2). Consistent with this perspective, Barab, Dodge, et al. (2010) used the worked example to illuminate the mechanism of

transformational play as part of an interactive publication to illustrate the theory in a contextually illustrative fashion. For that publication, the authors built the worked example by assembling purposively selected instances and multiple modes of discourse (videos, pictures, expositions, games, quotes, critiques, etc.) into an interactive tapestry, allowing visitors to engage the advanced theoretical claims along with contextual particulars that make the phenomenon visible. Consistent with our overriding motivation of demonstrating the value of transformational play, we believe that useful knowledge, especially for emerging phenomena that readers may never have experienced, becomes less meaningful when abstracted from the context of its origin. An important element of the scholarship challenge is to maintain the coupling of the theoretical claims with the contexts from which those claims were derived. The reader, therefore, is encouraged to explore in greater detail the cases presented in this article as worked examples that further illuminate our notions of transformational play (see Taiga Park at <http://workedexamples.org/projects/taiga-virtual-park> and Modern Prometheus at <http://workedexamples.org/projects/plague-world-a-modern-prometheus>).

Closing Thoughts

Games have become one of the most popular forms of entertainment in our society, recently surpassing Hollywood in annual sales. Surveys conducted by the Pew Internet and American Life Project demonstrated that videogaming as a leisurely pursuit is pervasive: 97% of youths and 53% of adults play videogames (Lenhart, Jones, & Macgill, 2008; Lenhart, Kahne, Middaugh, Macgill, Evans, & Vitak, 2008). Games are popular in part because they are fun. However, it is not simply their entertainment value that should be gaining the interest of educators. Instead, we have argued that it is the way games can draw players in, capturing their interest, time, commitment, and passion, that is the real value of the medium. Toward communicating the power of games, in this article we have advanced the notion of transformational play as an experiential target for educational game design. Designing for transformational play involves establishing academically useful and meaningfully engaging situations where learners adopt goals, have legitimate roles, and develop increasingly sophisticated relations to disciplinary concepts. They do so by experiencing and reflecting on the concepts' utility for making sense of and changing story lines in which the concept is relevant as an interpretive tool (e.g., using one's understanding of eutrophication to interpret the source of a water-quality problem in a virtual park). In such contexts, there is a shift away from dispensing facts and transmitting particular content and toward a commitment to supporting students as they enter into conceptually illuminating situations where they develop passions and apply content understanding.

More generally, it is our belief that videogames provide new technologies and methodologies for creating curriculum that is deeply immersive, highly interactive, and experientially consequential. Furthermore, games have the potential to liberate children from the stigma of assessment and to encourage a disposition for innovation and a desire to challenge oneself as a natural part of the learning process. In fact, simply mastering a game is an indication in itself that the player has learned; someone who has invested the hours required to reach an advanced level in a

game knows more about it than a beginner and can solve much more challenging problems. What's more, specific trajectories of game play (for example, as seen in log files) have the potential to reveal significant information about students' understandings of particular elements, once such trajectories have been identified. For example, Shute et al. (2010) discuss a stealth assessment model that involves embedding assessments into the fabric of the learning environment to both evaluate individual moments and assess complex systems relationships across multiple trajectories of participation. Thus information about students' understandings is revealed as they play the game and does not interrupt or take time away from their learning. Likewise, Schwartz et al. (2009) suggest that specific game choices can constitute a form of assessment in themselves: The choices players make (and the consequences of the choices) simultaneously inform the players and external observers about the depth of their understanding. Equally important, such assessments are engaging to children and encourage risk-taking and toleration of failure as part of the process (Gee, 2003).

Even when there are appropriate resources to support a field trip to a local park, for example, it is unlikely that the experience will cleanly illuminate the need for particular content understandings, and even less likely that students will be able to meaningfully transform some problematic aspect of the context—most parks are unwilling to put their future in the hands of a 10-year-old. Indeed, most teachers would be challenged to arrange classroom materials in a manner that could truly immerse learners in a dramatic narrative in which they act as protagonists, find legitimate roles, and interact meaningfully and consequentially with the story line. As a result, we regard games as offering a new pedagogy for the 21st century, a pedagogy that shifts learning from a process of rote acquisition to one in which conceptual understandings have personal and contextual significance, a pedagogy to inspire meaningful transformation by repositioning person, content, and context. We believe it is experiences like these, not simply passing test scores, that will ensure no child is left behind. For leaving no child behind involves allowing children to see themselves as individuals who can use academic content to transform situations that they care about. Videogames provide a unique opportunity where even novices can have such transformational experiences.

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¹Quest Atlantis is the creation of more than two-dozen team members, including the authors of this article, and hundreds of teachers and children who continually provide invaluable feedback.

²This calculation is based on the year ending June 5, 2010. To learn more, visit <http://QuestAtlantis.org>.

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