

# Are Games All Child's Play?

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## I. Two Views of Learning Games

Those who believe in using games in education usually start from a common set of assumptions. They observe that game player's regularly exhibit persistence, risk-taking, attention to detail and problem solving skills, all behaviors that ideally would be regularly demonstrated in school. They also agree that game environments enable players to construct understanding actively, and at individual paces, and that well-designed games enable players to advance on different paths at different rates in response to their interests and abilities, while also fostering collaboration and just-in-time learning. (Much has been written on this subject, but nowhere so comprehensively as in James Paul Gee's "What Video Games Can Teach Us About Literacy and Learning.")

Even starting with these shared notions, advocates for game-based learning tend to adopt one of two very different approaches to the question of games in formal education. One group sees the skills students develop playing games as essential to a 21<sup>st</sup> century education, and conversely despair of anything meaningful happening in schools still shackled to a 19<sup>th</sup> century factory model. They focus on the habits of mind and dispositions needed to collaborate, innovate, problem solve and communicate effectively in a knowledge-based economy. They observe with some accuracy that these skills can all be gained from engagement with commercial, off-the-shelf (COTS) games, or through social networking, blogging, and other forms of user-generated content that fall under the larger banner of participatory culture. They focus on these skills largely to the exclusion of traditional academic subject matter, and at least insofar as game-based learning is concerned, they assume the institution of school is highly resistant to reform and find alternate venues and opportunities to foster learning. They imagine the important learning will take place outside of school, and question what value school adds to the process. This group has demonstrated through its research that young people can and do use COTS games in many interesting ways and have shown that players can learn exciting and powerful new ideas, relevant to surviving and thriving the 21<sup>st</sup> century, through this play. They have done this primarily in the context of self-organized and self-motivated play, or through informal extracurricular organizations.

In contrast, the second group tends to concentrate only on applying games in school settings. They may pay lip service to 21<sup>st</sup> century skills, but they look at the learning that occurs in COTS games and ask, “Why can’t we have games that foster the same learning in more traditional academic areas?” In order to integrate games into the existing school environment, they must address several common concerns of the educational community, particularly teachers:

- The need to cover mandated content areas;
- Healthy skepticism of new technologies;
- Unfamiliarity with games, and no easy route to game competence.

In addition, proponents of games in school also have to overcome the objections of those parents, teachers and administrators who see games as insufficiently serious. The current solution to all these difficulties tends to be games that can be played in very short bursts of class time, games whose simplicity make them easy to grasp immediately, and games that are stuffed with what can be recognized as factual content. These games are often curricular, attempting to teach subject matter that is otherwise advanced through textbooks, lectures, or problem sets. Sadly, they usually end up being nothing more than interactive quizzes. The surface resemblance to a game means little when the activity involves answering multiple-choice questions and when success (or score) is measured solely as the percentage of correct answers given. If the first group embraces games and ignores school, this second group often embraces school to the detriment of anything that looks like real gaming.

In spite of their striking differences, we’ve pointedly avoided suggesting that these impulses – to promote new modes of learning on the one hand, and to adapt to the classroom on the other – are mutually exclusive. One might advocate that games can both build 21<sup>st</sup> century skills and channel those skills in traditional academic fields. One could also argue that just because such games might be in the service of school, they don’t necessarily have to be designed to blend into outmoded forms of schooling. Schools also have an opportunity to provide a needed service of reaching all students, and doing so in a way that may be facilitated by professionals trained in fostering learning. We should avoid these polarized viewpoints in order to both learn from and advance the cause of learning games.

We start with some sympathy for those who favor unrestrained gaming over schooling. We see enormous creativity in gamers. Mastering a game involves entering into often chaotic environments, learning through trial and error, observation, analysis, and systematic testing. When challenged, persistent players often engage in outside research, going to game FAQs and other websites to seek solutions to vexing problems (Gee 2003, Squire 2006, Steinkuehler 2008). And game play is often collaborative, as players share knowledge with fellow gamers both in person and on-line. Indeed, the culture of

problem-solving that surrounds gaming reveals the very dispositions desired in the 21st century workforce (Dede 2007).

On the other hand, while many young people learn extraordinary things from games, we believe that the children who make the most of these technologies tend to do so in the context of families or mentors (and sometimes schools) that support their efforts, or at the very least have modeled some of these same dispositions. For example, a study from the University of Michigan of children using computers in public libraries suggested that disadvantaged children were far less likely to spend time with single applications or sites, and tended to skim surfaces rather than dive deeply (Neuman & Celano, 2006). Structure and support from outside influences such as afterschool programs, parents, or a teacher in the classroom are needed for most kids to excel with these technologies. As such, we are not ready to concede there is no role for school in helping them make the most of these experiences. Quite the opposite in fact, we believe schools can and should play a critical role in fostering learning in association with game play. And while schools have much room for improvement, many of the existing assets of school can contribute positively.

Whatever the failings of school, the academic disciplines of math and science, history, literature, language study remain vitally important, as do the abilities to read critically and communicate persuasively both in and out of school. In all of these fields, talented teachers and researchers have identified pedagogical approaches that are forward looking and well-adapted to the changing environment of the Internet age, approaches that rely on the same thinking skills that games exercise. There is no reason to believe that the kind of creative energy exhibited in games wouldn't apply to these disciplines. And talented teachers have long known that non-academic texts from novels to theater to film all have a role in sparking interest and curiosity in students, as have informal experiences such as museum visits and competitive challenges such as science fairs.

We are therefore prepared to argue that:

1. games can engage players in learning that is specifically applicable to "schooling;" and
2. teachers can leverage the learning in such games without disrupting the worlds of either play or school.

To succeed, we must look at where the strengths and challenges of both classrooms and games lie and situate learning games at the most productive intersection of these separate environments. We will examine these issues through concrete examples of existing best practices, and speculative designs currently under development at MIT's Education Arcade, and elsewhere.

## II. The Role of Play

The starkly obvious difference between games and traditional schooling is that good games always involve play, and schooling rarely does. Before we discuss what constitutes play in games, it's worth stepping back to look at play in the broader sense.

Think for a moment about a child at play with dolls or action figures or Lego blocks. To the outsider, the play is likely to look somewhat scattered: the child will be working fiercely one moment constructing a building or acting out a story, and then just as abruptly the child will shift gears, knocking down what she's built, or hurling dolls across the room in gleeful enactment of imagined disasters. Whether the child has been exploring the physical nature of things, her nascent understanding of familial and social roles, or obliterating everything she's just accomplished, the child at play is exercising freedom along four distinct axes:

1. **freedom to fail;**
2. **freedom to experiment;**
3. **freedom to fashion identities; and**
4. **freedom of effort.**

**Freedom to Fail:** One doesn't actually fail at play per se, but one is free to do things at play that would look like failure in other contexts. Think of the block tower that inevitably collapses or the sand castle fated to disappear with the tide. At play the child has unlimited freedom to undertake such doomed enterprises, and learns as much about the nature of things from failure as from success. Every fall off a bicycle, every crumpled up drawing, every lost game of Candyland is a small failure. Fortunately, children at play don't have adults looming over them, fretting about the cost of these failures, and so children are free to learn from failure and move ever closer to mastery of their world.

**Freedom to Experiment:** This correlates closely with the freedom to fail, but suggests in addition that within the play space the player has some room to maneuver and invent new approaches to whatever task is at hand. It isn't sufficient that the child can build towers with blocks, but in fact she can engage in a wide array of activities with those blocks, experimenting with uses she has invented for herself. Experimentation would be meaningless without the ability to fail regularly, and the freedom to fail would amount to little if players were constrained in where they could seek that failure.

**Freedom to Fashion Identities:** At play, the child isn't simply examining the nature of the physical and social worlds, but is also exploring her identity in those worlds. That identity is not a fixed thing, but rather something that is itself "in play." Using dolls, a child will try out the roles of both mischievous child and stern parent. In fairy tales children imagine what it means to be a dragon, and what it means to slay one. The child is practicing when to be aggressive,

when cooperative, when assertive and when docile. Only by trying on these identities do children begin to define themselves.

**Freedom of Effort:** Watching children play tag, Peter and Iona Opie (1969) noticed that a child will run vigorously for 20 minutes to evade the tag, and then abruptly stop in the middle of the school yard to receive the tag. They observed that children regularly exhibited this pattern of alternating between intense and relaxed play. It is easy to overlook this quality of play, but if we stop to imagine play in which a uniform effort is expected, we quickly sense the presence of a controlling adult.

## **Play and Games**

What we've largely described above is free play – the sort of play a child pursues entirely on her own terms. This play has no agenda, and the child's goals are entirely intrinsic and personal. Games by contrast, tend to have defined goals. Most games have "win" states, and even those that don't end in victory usually have clear ways of demarcating success through points or other quantifiable outcomes. In addition, games have rules that structure the play, and that guarantee fairness by being applied transparently and equitably to all players.

At first blush, games, with their rules, constraints, and externally defined goals seem to be at odds with the freedoms of play. But within the proscribed space of a game, players regularly exhibit all of the freedoms of unstructured play. Most players undertake games in the knowledge that failure is a possibility. They show a willingness to experiment in their game-play, and to try on different roles from leader to follower, novice to expert. Finally the freedom of effort described above remains present in any voluntary game.

By offering challenges that seem worth attempting, games actually focus and channel players' efforts, while still allowing them the freedom needed to manage their individual experience in ways that are self-directed and beneficial to their own development. In games, children submit to arbitrary rules and structures, but only if they can continue to be playful. The promise of games is that we can harness the spirit of play to enable players to build new cognitive structures and ideas of substance.

## **Play and Adults**

In providing the above examples, we've stuck with descriptions of young children at play, as it is in childhood play that these features are most easily recognized. But the same freedoms are visible in the play of adults. Mastering golf - that most adult of games - would be impossible without the ability to fail often and quite spectacularly. And no one would get good at poker if they couldn't experiment, or try on different identities. Anyone who regularly plays tennis knows that sometimes you come to play hard, and sometimes you decide

to relax and just volley. Without the four freedoms of play, none of these activities would be worthy of the name 'leisure.'

### **Games vs. School and the Freedoms of Play**

One might argue that the same freedoms should be present in learning, and indeed many good teachers make room for all these freedoms in their classrooms. But much of the structure of school militates against the exercise of those freedoms. The emphasis on grades and high stakes testing leave few opportunities for failure or varied effort. Experimentation doesn't even make it into the one place you'd expect to find it, the traditional science class, where labs are usually done according to rigid recipes with pre-ordained outcomes. And the need for classroom order and regularity rule out the possibility of playing with one's identity.

If the spirit of play sits uncomfortably in too many classrooms, the logistics of game-play are even more problematic for schools. The mere process of implementing computer based learning activities, typically requires dealing with the "computer room" in the school. The computer room itself has a multitude of associated difficulties. First it involves transporting a class full of students from one location to another, which takes time in an already crowded schedule. Second, that room is often crowded with computers and not particularly hospitable to activities that take place off of the computer. Third, due to understaffing, the computers in these rooms are simultaneously locked down to prevent unauthorized software from being installed (including games), and notoriously unreliable. Finally, sustained activities are difficult to take on, due to over-scheduling of the existing resources. These challenges create an obstacle that few teachers feel prepared to tackle, even if they have the motivation to integrate games into their teaching.

Providing further obstacles, is the need to march students through mandated curricula, with little time for exploratory and creative activities. Nearly all classroom activities have to be justified through their relevance to the state standards, which are bogged down in the details of content, and scarce on 21<sup>st</sup> skills, such as New Media Literacies (Jenkins et al., 2006). Combining all of these factors with the very real concerns of teachers when confronted with new and unfamiliar technologies creates an environment in which games just aren't likely to be adopted, or when they are, to be used in limited and unproductive ways.

If we have highlighted here the disparity between the worlds of games and schools, our purpose is not to offer discouragement, but rather to encourage a clear-eyed sense of the challenges in integrating the two. The design of good learning games can only emerge when the obstacles that stand in their way are fully accounted for. We believe that the answer lies both in the design of games meant to fortify academic learning, and in new and creative ways of imagining the integration of those games into schooling.

### **III. Design Principles for Learning Games**

We believe there are a number of design principles that should be taken into account in the creation of learning games. These principles can be grouped under the broader categories of activity, structure, and narrative. We will define these terms and consider each in turn. But first, as a basis for this discussion, we'll describe LURE OF THE LABYRINTH, a game designed by the Education Arcade, and currently being developed in collaboration with Maryland Public Television, Fablevision, Johns Hopkins University, and Macro International. It is funded by the U.S. Department of Education as part of its Star Schools program. We'll start with a brief description of the game, and one of the puzzle environments within it.

#### **The Story**

LURE OF THE LABYRINTH'S (LABYRINTH'S) target audience is middle school students, and its primary goal is the enhancement of pre-algebra mathematics learning, with a secondary goal of improving literacy. It is a long-form puzzle adventure game played over many sessions, with a persistent narrative that evolves over time. In the story of the game, the player's avatar is a young person trying to recover a pet that has disappeared. Following clues, the player is led into a fantasy world - an underground factory complex populated by mythical monsters who are kidnapping pets and using them for nefarious purposes. By the game's conclusion, players will have recovered their own pets, freed many others, and halted the monsters' plans by destroying their factory. In order to accomplish this, players must explore the space, learn how to navigate it, and collaborate with others to accumulate credits by solving puzzles. These credits will in turn be used to free pets and to thwart the monsters' plans.

LABYRINTH'S story is told in comic form. Comics enable us to deliver a significantly more involved story for our production budget than would traditional animation, but our enthusiasm for the form is not primarily economic. Comics promote both verbal and visual literacy, and they leave more room for players' imaginations, both in the ways they imagine the voices of the characters and sound effects, and in the ways they fill in the visual details between each comic frame. With comics, players remain in control of the element of time. Rather than absorb a story told to them at a fixed pace, they take it in at their own pace. They read rather than simply watch.

#### **Delivery**

LABYRINTH is developed in Flash, and served over the web. It can be played from within the browser of any reasonably current internet-enabled computer. The game's server keeps track of individual log-ins and tracks player progress, so once players have enrolled, they can rejoin their games from any connected computer. This form of delivery has several significant strengths.

- The game does not need to be installed on individual computers, something that is often a challenge in schools or libraries.
- Because the game server keeps track of each player's unique log-in, the game does not depend on players always using the same machine. This enables players to play from home as well as school, and it is particularly important for disadvantaged students who may only get to play in libraries or after-school settings.
- Saving player progress makes it possible to deliver a long-form game. (Labyrinth might take as many as 15 hours to play.) This enables a more involved narrative, which in turn promotes a greater degree of investment on the part of the player. It also makes it possible for the game to pose challenges of greater intellectual depth, as we can anticipate that players will have more time to reflect and solve each puzzle.
- Since the game keeps track of player's progress, teachers can use this data to better assess and supplement their students' achievements.

As we have suggested above, we designed Labyrinth to be played at home or in other informal settings as well as in school. This is a critical factor in our vision of the integration of the worlds of play and school, and one which we will expand upon further in this article.

### **A Typical Puzzle**

A typical LABYRINTH puzzle involves a strange vending machine serving unappetizing snacks that only a monster could love. Upon entering the puzzle, players only know that they are supposed to get food from the machine. Lacking other instructions, they must figure out how the whole puzzle works. What the player sees is the machine, with a number of food items behind glass doors. Under each item is a different number. To the right of the machine are three piles of round discs, each pile a different color.

Playful players, as most kids are, immediately begin clicking around the screen. They discover that clicking on items has no effect, and eventually discover that the colored disks can be picked up and moved around the screen. In time they also notice that the machine includes three slots into which these disks can fit. When the slots are all filled, the disks fall into the machine, sounding like coins, and an item drops out. It is up to the player to interpret what has happened. Initially players usually try one coin of each color, and their second try is frequently the same three colors, but placed in different slots. When players realize that simply placing the same coins in a different order always yields objects of the same numerical value, most conclude that the disks are coins of different denominations adding up to the value of whatever item the machine vends. At this point they begin trying to deduce the values of each coin by trying different combinations, and eventually they use this knowledge to retrieve



certain items that they come to recognize as “target” items. As you may have gathered, solving this puzzle requires algebraic thinking, as players must solve for the variables represented by the unmarked coins.

Players don’t usually succeed on the first try. It may take a while to figure out the apparatus, or to recognize that there are target items. In these early attempts, players run out of turns, the machine powers down, and they must start again. But even as they are not fully succeeding, they are getting some items out of the machine, and for their efforts they are earning points. In every Labyrinth puzzle, players earn some points for effort, or for partial successes, though never as many as when they completely solve the puzzle. As such, while failure has consequences, it is easy to pick oneself up and try the puzzle again.

While players are still trying to master a puzzle they are not confined to working solely on that particular puzzle. Players can quickly earn access to all the puzzles in the game. The game also involves a large virtual space that the players can wander through and explore. Through this exploration they will discover other items that must be collected to win the game. In other words, players enter into an environment in which a wide range of activities are always open to them, all in the service of achieving their game goals.

Players who do work on solving the puzzle learn that every time they play it, the values of the coins are different. They discover that their challenge is not in memorizing the value of the coins, but rather in developing foolproof strategies that will enable them to solve for any possible array of values (and often unbeknownst to them, tackling fundamental algebraic understanding in the process). Once they’ve mastered the puzzle, they are rewarded for their success, but also challenged to try solving more difficult versions of the same puzzle.

Finally, throughout the game, players are in communication with teammates via an in-game message board. Players can seek or give advice about solving individual puzzles, or about the overarching game goals. Since answers to puzzles are never the same twice, in order to help each other teammates must write about what strategies they use for solving them. They must write about the underlying mechanisms of the puzzles, not just their solutions. This skill of articulating the solution, makes them valuable team members, and also builds skills required on many standardized assessments.

### **Design Principles: Activity**

A games’ activity, what is often referred to as its “mechanic,” is that action the player performs in playing the game. The activities in individual LABYRINTH puzzles are different at their basic level – putting coins in slots in the example above, mixing quantities of liquids in another one – but at a larger level, all the **puzzles are about learning to act like a scientist, mathematician or engineer.** Players enter a chaotic environment in which nothing initially makes sense.

Through probing, sometimes random, sometimes focused, players initiate actions and see results. Players must carefully observe the environment's response to the stimuli they introduce. They gradually form hypotheses about what processes are at work, and learn to test those hypotheses by altering single variables as they initiate new actions.

**Playing the game is not about memorizing solutions, but about learning strategies, processes, and habits of mind.** As such, it aligns with the so-called 21<sup>st</sup> century skills, but in reality it is mirroring the habits of mathematicians and scientists from the Enlightenment forward. While it is arguable that these kinds of process skills should have always been the goal of a good education, in the Internet age, with mountains of data at almost everyone's fingertips, it is ever clearer that memorizing facts is no substitute for having solid strategies for manipulating abstractions, data, and ideas. Although LURE OF THE LABYRINTH focuses on the process of mathematics, one can imagine that games would similarly model the behavior of historians, policy-makers, or designers.

**Players intuitively understand that "wrong" answers are part of getting the right answer.** Because solving a puzzle involves probing and interpreting responses to successful *and* unsuccessful stimuli, the game models the notion that small failures often lie on the path to larger successes. While this may be self-evident about games, it's worth noting that many academic exercises and many "educational" games do little more than tell a student that they are wrong without giving feedback that would make it possible to reason about what is correct.

**Players engage with content in a context.** The game looks for ways to make the abstractions of mathematics concrete. Although it does so in the mythical world of a fantasy game, the activities nevertheless have real-life parallels. Indeed, the game uses relatively little mathematical notation and, where it can, enables the players to reason about numbers as quantities, volumes, or magnitudes, not just numerals on a screen.

**Activities are tactile, and offer sensory satisfaction.** Although computers have limited inputs and outputs, clever use of animation and sound can make the activity pleasing, thereby fostering greater engagement and investment in activities. When items come out of the vending machine in LABYRINTH with a satisfying "ca-ching", the game is providing sensory reinforcement to the intrinsic pleasure of successful problem solving. It is not sufficient for designers to create mechanisms that distinguish right from wrong answers and reward points accordingly, they must also create worlds where the intrinsic satisfaction of successful play are sufficient to overcome the frustration of initial failures. Indeed, in LABYRINTH we strove to make the feedback for wrong answers as entertaining and amusing as for right answers. Far from feeling the need to provide harshly negative feedback, we trust players to reach for success, and we

want them to feel some reward simply in making the effort. In fact many players will try wrong solutions solely for the purpose of seeing what happens. This encourages them to push the boundaries of their understanding and expand their potential for learning. That said, we never give false positive feedback, and design responses so players can easily distinguish between full and partial success.

**Players build scaffolding for future learning.** LURE OF THE LABYRINTH is not courseware, and we don't expect players to "cover" the curriculum while playing. Rather we have created mechanisms whereby players can engage with some of the big ideas of mathematics while remaining playful. Because the game fosters deep, repeated engagement with these ideas, we expect that players will have begun to master them even before they encounter the concepts in school. We will say more about this shortly.

**Avoiding time pressure enables collaboration and conversation.** Playing against a clock, and the time pressure that comes with it, often makes for an exciting game, but there are several good reasons to avoid time pressure as a factor in game activities. When there is time pressure, players have a hard time collaborating, as the more aggressive or confident player will want to seize the mouse and control the game. Remove that pressure and players become willing to discuss each move before it is made. The need to discuss and justify decisions will sharpen players' thinking, and enable them to both teach and learn in the course of the game play. If students can play collaboratively and discuss their ideas, it is usually possible for teachers to observe their game play and acquire greater understanding of their thinking. When immersed in time-sensitive game play, players can be annoyed by observers' questions, but when playing in a more relaxed mode, they are usually proud to discuss their strategies and show off their accomplishments.

There are nevertheless ways to replicate the excitement that the game clock brings. If games are designed so that players must achieve certain goals within a limited number of moves, the excitement mounts with every move the player makes. Learning to solve problems efficiently, and with the minimum number of moves may be a better analogue to real life problem solving than is the need to simply think fast.

### **Design Principles: Structure**

A game is more than a collection of individual activities. The game's larger structure determines the patterns by which players will engage in individual activities. The games system of scoring and rewards will have a powerful affect on how players progress through its landscape, and how they define their own personal goals. While many different game structures can make for a pleasurable game, there are certain key elements that will, we believe, enhance learning.

**Players make multiple passages through each challenge.** In LABYRINTH, winning is achieved by accumulating points (represented as “credits” which are a kind of currency). These points can be earned by replaying the same puzzle several times – something that remains entertaining, as the solution differs every time a puzzle is played. Indeed, we don’t expect players to solve the puzzle the first time they encounter it, and so they will have to engage with the puzzle repeatedly. While repetition is necessary for increasing one’s score, there is a pedagogical purpose as well. It has been our observation that players are usually on the edge of comprehension when they master a puzzle for the first time. By giving them incentives to solve a puzzle several times, we expect them to solidify their understanding, and to build a more robust scaffolding of the puzzle’s embedded ideas. In LABYRINTH we require a player to solve a puzzle three times before we credit them with “beating” it, at which time the game invites them to engage with a harder version of the same puzzle, one that will introduce new complexities and further deepen their understanding.

**Offer partial reward for partial success.** Players accumulate points just for trying to solve puzzles. Not only does this provide incentive for continued effort, but also it reflects the fact that for many difficult challenges, the very process of trying to solve the problem is as important as finally getting the right answer. Not all the struggles in students’ intellectual lives will be winnable, but they should begin to experience the pleasure of simply trying.

**Nurture emerging ideas.** LABYRINTH puzzles are designed to reflect concepts such as proportionality or coordinate systems. Our own observation is that players don’t understand these concepts all at once, but actually grope toward understanding in stages. For example, we’ve seen students begin to recognize correspondence between the first coordinate in a pair, and its position on the X-axis without yet understanding that the other coordinate represents a position on the Y-axis. The big “a-ha” when a student finally sees the whole system is preceded by a long period in which the idea emerges bit by bit. This is an additional reason for encouraging repeat engagement with a challenge, and for offering partial rewards.

**Offer clear incentives for more success.** While we do offer rewards for simply trying, the rewards for full success are clearly denoted. We start with the assumption that all players are, at the heart of the matter, really competing with themselves. They play to achieve mastery, i.e. to improve on their own initial efforts. While this goal is fundamentally an intrinsic one, enjoyment of the game increases if its reward structure mirrors the players’ goals. Rewards should therefore be significant when the player makes significant progress.

**Avoid Brick Walls.** Many games don’t allow players to pass through specific points until they have mastered particular challenges. The game designers probably think that they are enforcing a pedagogically valid sequence of

learning, but these “brick walls” often lead to discouragement and to players abandoning the game. They also fail to take into account different learning styles, and the kind of emergent ideas that we discuss above, and allow for in our design. LABYRINTH allows players to advance on many different fronts at the same time. If one path is blocked by a difficult challenge, the player is free to take a break and try a different path. Indeed the game can be won without completely mastering any one puzzle. We trust players to rise to the challenges we put before them, but we know that in order to remain playful, they must have maximal control over the way they meet those challenges.

**Allow more than one way to win.** We have explained why games should reward partial success, and avoid brick walls. In the same spirit, we enable players to bring their game to a satisfying ending without requiring that every player accomplish exactly the same goals. One player might master every puzzle, and march quickly and directly to the game’s conclusion. Another player might struggle, and fail to fully beat every puzzle, but this player can nevertheless achieve a win state through the gradual accumulation of points. In keeping with the principle of offering clear incentives for greater success, the first player will earn a much higher score, and may achieve other markers (bonus point, etc.) reflective of that achievement. In order to get a win without total mastery, less accomplished players will have to spend significantly more time, but their persistence will be rewarded and the repetition increases the likelihood that core ideas will eventually be mastered. We assume that players will recognize the difference between the multiple forms of victory, and that they can decide for themselves whether to try again for a higher score.

### **Design Principles: Narrative**

Many good games have little or no formal narrative (Chess, Tetris) and the absence of narrative doesn’t necessarily say anything about a game’s worth. Nevertheless, it’s also clear that many games, including the majority of computer games do have a narrative component, and that players are very much drawn to the characters and plots of games. It’s therefore important to examine what narrative features might make a game.

**The game world should embody the subject matter.** It isn’t sufficient to simply create a compelling narrative into which you insert quizzes about unrelated content. Rather the game world should engage players’ imagination with the very themes and ideas that animate the learning goals. For example, the Education Arcade is currently designing a language learning game. Since learning a language is about gaining entry to a world that is otherwise off limits, this game’s story will involve characters starting as outsiders and gaining status as they master the game’s challenges. In the same vein, a game about history might involve players in examining past events, whether fictional or real. While this might be achieved through a strategy game like CIVILIZATION, which focuses

on the spread of actual historical empires, it might also be achieved through a narrative that takes the form of a murder mystery, with a detective protagonist examining documents and conflicting accounts of past events.

A science game might involve players in a world whose workings are mysterious and in need of decoding. LABYRINTH is set in a factory where the player is required to engage with machines whose operation depend on the manipulations of quantities, magnitudes, and rates of change.

**The game world should allow players to explore their identity.** Many games allow players to customize their avatar, and in the process try on different identities. Some games even let players decide whether they want their characters to be good or evil. These choices invite players to engage with the game in more imaginative and playful ways, and we believe this in turn will lead to more creative problem solving in the course of game play. It also situates the game more authentically in students' emotional lives, where they are regularly experimenting with different aspects of self and personal identity. This kind of role-playing can be particularly relevant to the study of literature, social studies and language, where empathy and the ability to imagine the lives of others are important

**Games should not patronize or flatter.** Too many learning games patronize young players by trying too hard to be cute or nice. Big-eyed cartoon characters talk in overly demonstrative ways, much the way some adults over-articulate when talking to young children. Failing to recognize that children's lives include darkness as well as joy, these games present narratives with all the drama of a Sunday school picnic. Other games try to flatter children by presenting narratives about unrelentingly "cool" kids who can do no wrong (and who are likely to appear more cool to adults than to children). In fact, children live in a world whose rules are confusing and often arbitrary. They are still learning where to be brave and take risks, when to trust in others, and what their own reserves are. Many of the commercial games children play engage with these issues through their narrative, and there is no reason that learning games shouldn't do the same.

**Games can be non-gendered.** The issue of gender in games is too complex to receive a proper treatment here, but it is at least worth pointing out that there are alternatives to games that are perceived of as male (games about personal combat, espionage, and warfare) and those rare attempts to create games that are explicitly female (games about girls socializing, clothing design, or cute fantasy worlds). We will side-step the question as to whether these highly gendered games have their place, and simply observe that there is vast room to maneuver between these extremes. LABYRINTH for example blends themes that might be perceived of as female (saving small animals), and male (gross and slimy monsters), but its underlying theme is about persistence and creative problem

solving. It blends the pro-social theme of teaming up with others to protect the world with moments of individual heroism. Players are free to imagine their avatars as male or female, and the monsters they encounter appear to play roles within the factory totally without regard to gender. Great literature rarely occupies spaces that are explicitly male or female, and there is no reason why our game narratives should be any more narrowly gendered.

#### **IV. Integration of Play and the Classroom**

At the outset of this article, we discussed the ways in which the worlds of play and the classroom were at odds, and we enumerated the impediments to the adoption of meaningful game experiences in the school day. Though we have tried to argue that players learn best from games that remain playful, we have said little about how these games might be used in school. We did hint at some possibilities in our discussion of LABYRINTH, but that now bears amplification.

**Allow the game to be played outside of school.** Although LABYRINTH's flash-based web delivery is well suited to school computers, we actually hope that the game will largely be played outside of school. We want students to undertake the game with the four freedoms of play intact. If most of the game play occurs outside of the classroom, teachers don't need to commit scarce classroom time to technologies that, in their eyes, remain unproven. On the other hand, assigning it to students may be a satisfactory alternative to other forms of homework – though students shouldn't be graded on their game play if we want them to play freely.

**Use games as preparation for formal learning.** We have mentioned that LABYRINTH is not courseware focusing on the minutiae of standard curricula, but rather it engages with the big ideas of mathematics. We don't expect students to play the game and immediately score higher on standard assessments. But we do expect students who play it to be armed with new mathematical concepts and models, understandings we hope teachers will be able to build upon. We hope that the game will be assigned to students at the start of the academic year or even the summer before, and that teachers will be able to reference the game experience throughout the year.

**Make minimal demands upon teachers' technical knowledge.** Teachers can launch LABYRINTH in their classrooms simply by filling out a single web-based form. After that, all they need to do to get started is pass on to students the URL and login information that the game provides. Most middle-school students should know how to log into a web site, and most of them will be comfortable entering game environments without instructions. Since students will be teamed with classmates in the game, those few who are less fluent with games should be able to get help from their teammates. Teachers don't initially need to know how to play the game, though of course they will receive plenty of supporting

material to help them do so. Since students can be up and running without instruction, teachers can catch up on the game gradually, and at their leisure.

**Let the students demonstrate expertise.** The world of computer games is one in which many students already feel confident. A teacher might easily encourage the students to play the game, and a week or two later ask a student for help in getting started himself. It can be wonderfully empowering for a student to be invited to instruct the teacher, and to display authentic mastery.

**Use games as thought starters and visualization tools.** While we don't expect LABYRINTH to be played extensively in class, we do give teachers tools to bring it into the classroom in a targeted way. Even a teacher who hasn't played much of the game has the means to bring up any individual puzzle on a classroom computer, and we provide materials that relate each puzzle to standard curricula. Imagine a teacher telling her class, "I know we've never discussed variables before, but I also know that you are all pretty good at working with them. Do you remember when you played the Vending Machine puzzle?" At this point the teacher projects the puzzle on the classroom screen, and asks the students to talk about the strategies they used to solve the puzzle. Instead of treating each new topic as another area in which students are neophytes, the teacher can leverage the students' authentic achievements within the game, treating them as accomplished math students and giving them the confidence to go deeper. Furthermore, the game employs imaginative ways of visualizing mathematical concepts, and teachers as well as students may find these to be useful alternatives to the abstract forms in which these concepts are usually presented in textbooks.

**Use games as pre-assessments.** LABYRINTH player data is stored on a central server, and teachers can log on to see how far each student has advanced through the game, but also to read the team message boards where players will demonstrate their understanding through the questions they ask and the strategic help they give teammates. While we wouldn't endorse the use of this data for determining grades, we do think it can give the teacher powerful insights into students' thinking. Teachers can more carefully tailor their instruction when they know more about what topics the students have already mastered, and where they are struggling. In our own work we've seen kids who aren't considered strong math students nevertheless display genuine ability in the context of a game. We would love it if teachers could use games to discover talents and insights that students don't otherwise display in the classroom.

### **One step at a time.**

We've described above a use of learning games that preserves what is playful about games, and one that has some reasonable chance of being adopted in schools, as it requires relatively little class time, and doesn't demand too much of teachers all at once. We are fully aware that there are still barriers to this model's



widespread acceptance. Teachers must not only embrace the idea that learning occurs in games, but they must also give up a measure of control, trusting that students can make their way through games with minimal instruction. And there must be good materials to help teachers relate the learning in games to traditional academic disciplines.

On the other hand, this is an approach that doesn't require teachers to radically alter their classroom style or abandon existing curricula. It is one with which teachers can experiment, lightly at first, more thoroughly as they gain confidence.

While we share the desire for a radically transformed classroom in which students are allowed to more freely pursue their interests and develop their talents using a range of tools with or without technology, we know that vision has advanced little during two decades of computers in schools. We have either asked schools to embrace technological change wholesale, or we have asked technologists to dumb-down their products to accommodate the classroom of today. Perhaps the time has come to further develop the marginal space where the two worlds of school and play meet. It may be a challenge, but what good game isn't challenging?

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