Unifying *Education* and *Game* in Educational Games

Scot Osterweil
Alec Chane Austin
Kristina Drzaic
Dan Roy

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Is the term **educational game** an oxymoron? It is if you think of education as the formal transmission of knowledge from the informed to the ignorant, and games as the trivial things children do when they are not more constructively engaged. While few contemporary educators would endorse such a stark formulation, in practice many behave as if were true. Games are scrupulously kept out of the classroom, except as rewards for completed work or during unavoidable downtime. And we model much of our school day and its curricula as if education were nothing but didactic knowledge transmission, even though we regard that approach as too simplistic.

Happily, we have entered an age where many now accept the notion that play is indeed a kind of learning, and scholars have identified the myriad ways in which game players are developing problem solving skills and collaborative practices, and learning procedures and habits of mind that will serve them well in their formal education. But while we now acknowledge the educational potential in games, we have not yet developed an organized taxonomy of those game elements that promote learning. Nor have we articulated well the hand-off between the learning in a game and the learning that goes on in school. Lacking the necessary analysis about what makes a good learning game, we often fall back on hobbled notions of educational games, in which brief interactive drills are inserted into precious classroom time. Failing to engage students' imagination or playfulness, such pseudo-games don't deliver on the promise of educational games, and are little better than electronic worksheets.

In designing LEARNING GAMES TO GO, we are calling upon our own prior experience with game play and game design to create what we hope will be a robust model that engages students in the "serious fun" of game play, while giving teachers entry points that allow them to connect the informal play to formal instruction. If we do it right, students will use the game to build a scaffolding of new concepts, and teachers will provide the depth of information and practice that enable that scaffolding to support fuller understanding.

We see three fundamental elements of any game that must be in dynamic balance for a game to promote effective learning. These elements are: game activity, game structure,

and game narrative.

The game activities (sometimes called the game "mechanic") are those things that the player is called upon to do in executing the game. For example, the game activity of chess is moving the pieces in set patterns and capturing the opponent pieces. In baseball the activity is pitching, hitting, catching, throwing, and running.
Game structure refers to the ways in which these activities are organized within a set of rules. The structure of baseball includes its nine innings, and taking turns at bat or in the field whenever 3 outs are recorded.

Game narrative comes into play even in such elemental games as tic-tac-toe, but our consciousness of game narrative is heightened in the age of computer games. These games are often embodied as complex animated adventures that at their best can be as emotionally affecting as movies or novels. Game narrative provides additional goals and motivation for moving forward within a game, fortifying the intrinsic motivation of winning.
How each of these elements influences the effectiveness of educational games will be the focus of this paper.

I. Game Activities

Game players are motivated to master a game's activities, and so in that context they are motivated to learn. They may be learning a new skill, reinforcing a known skill, forming a hypothesis about a puzzle and then testing it, learning to work in a team, or simply becoming acquainted with the game's setting and story. In designing learning games we need to understand the learning that goes on in game play, and harness it in the service of content areas that we target.

Sometimes players learn within games by memorizing information presented repeatedly or with emotional weight. For instance, in a racing game with detailed cars, players quickly become familiar with each car's handling, acceleration, breaking, and top speed.
They attach this experiential knowledge to the visual representation of each car presented on the selection screen. They learn this information because they repeatedly see each of these characteristics in their performance on the racetrack. They also learn this information because each characteristic that impairs their performance becomes a source of frustration and maybe even embarrassment whereas characteristics that bolster their performances result in excitement, and pride.

In multi-player games, players learn to function as members of teams. Being a good team member means communicating well. It means knowing one's role and executing it effectively. It means motivating and consoling teammates. It means learning to give and take constructive feedback. It means minimizing temper and ego. In some online multi-player games players desiring to undertake quests will need to organize a team whose members' abilities complement each other, herd them all to the same part of the game world, communicate to everyone their roles and responsibilities, and then, while completing the quest under time pressure, quickly dispense tactical advice. Some larger quests may require dozens of players. And guilds (long-term groups

of players who frequently team up with each other) require even more leadership and organization. It's common for guilds to have web sites, mailing lists, weekly meetings with agendas, and all of the other trappings of 21st-century enterprises.

Games that involve any kind of time pressure can teach mental multitasking. For instance, real-time strategy games require players to build and manage several bases (basically military-focused cities), give tactical orders to individual troops, and strategize with teammates all under severe time pressure. Maintaining composure under pressure is the only way to win, and it's a skill that transfers out of the game.

Games that involve physical dexterity (usually of the fingers), can teach fine motor skills and hand-eye coordination. This may not seem like the most valuable skill in an age of information workers, but certain specialized professionals like surgeons see its value.
Surgeons have begun to use games for three purposes: to practice dangerous surgery techniques in a simulated environment rather than on a patient, to “warm up” even before routine surgeries, and to test current alertness and response time as a predictor of surgery success.

But perhaps the most salient learning occurring in game play (and it occurs in many types of games) is the learning that comes through systematic exploration and observation. Playing any computer game means experimenting in a micro-world to discover its rules, and then taking advantage of those rules to operate effectively within the world. Experimenting begins when players interact with the game world, pose questions and develop hypotheses. For example, in a game that involves traversing a realistic environment, players question how closely the game world represents reality.
“How quickly can I run? If I jump and fall too far, will I be hurt? Can I breathe underwater?” To answer these questions, players run as fast as they can, jump off of cliffs or buildings, and submerge their avatars for minutes on end. If avatars jump from
great heights uninjured, players may search for a higher jump to test the new hypothesis that falling any distance does not result in injury. If jumping from a higher ledge does lead to damage, then the player may search for a higher jump with water below to see if that softens the fall. Players continually construct and refine models of each new world.
Not until they understand the limits of the world can they effectively overcome its obstacles.

This activity—observation, hypotheses formation, and experimentation—mirrors the rigorous intellectual practice that students should apply to all forms of problem solving.
We believe the best learning games will entice students to engage in these very activities in the context of content relevant to academics. Whether solving a mathematical puzzle, understanding a mechanical process, predicting scientific phenomena, or deconstructing historical narratives, players of learning games should be challenged to employ their repertoire of game skills to substantive intellectual challenges.

II. Game Structure

The structure of an interesting game combines repetition and variation: repetition so the game can be understood, and variation so that the game remains interesting and challenging. Both qualities

are also vital to the learning process. While an individual activity or encounter can often be mastered by rote, if players must deal with continually evolving instantiations of that activity, they will eventually begin to see patterns, logic, and structure, grasping the underlying principles of the activity. This process of pattern recognition, leads to the development of powerful heuristics and algorithms that players can use to solve entire classes of problems, instead of having to start anew whenever they meet fresh challenges.

In learning games, we therefore look to the structure to provide the player with a series of incentives and rewards that promote continued play and encourage players to go deeper (rather than give up when faced with obstacles). Such structures should encourage both the naive and the expert player to excel, and reward effort without confusing it with success. These rewards can be in-game rewards (such as treasures or additional abilities), or they can be visceral, sensory, or narrative rewards (a pleasant sound confirming success, the story taking a turn toward a happier ending). Either kind of reward is really just a manifestation of the intrinsic reward the player feels for making progress.

That games usually reward success is neither surprising nor controversial. What we think is critical in a learning game is the fine-tuning of the rewards the player receives simply for effort. We have observed that along the way to mastering a concept, a learner/player will often go through a period of "thrashing"—a bout of activity that doesn't seem to reflect any understanding of the challenge at hand. It has regularly been gratifying to see players in such circumstances suddenly achieve a flash of insight about the puzzle or obstacle they've been wrestling with. These insights don't usually emerge from studious pondering but rather from repeated, seemingly aimless play. As an incentive to *thrashing*, we believe that games should reward players' effort even when those efforts have not yet yielded results. The challenge is to have a varied system of rewards that clearly distinguishes between promising effort and all-out success. A player who has worked hard should be able to point to game results that reflect effort, while also aspiring to the additional rewards that come from mastery.

III. Game Narrative

Long ago, the Greeks recognized that at the heart of every good narrative was *Agon*, or struggle. Agon is also the word the Greeks used for competition. That is appropriate, as conflict that fuels a good story has much in common with the competitive struggle that naturally arises in games, whether between teams, individual players, or nowadays between players and computers (for most computer games actually pit the player against the machine).

On one level, the narrative of every game is "I struggled." Listen to people relate their experiences at golf or PacMan or poker and you will hear a story about a player coming new to a game with no skill or experience, who through dint of hard work (and maybe some luck) eventually achieves mastery. The meta-narrative of every game is an Agon in which the player is the prot*agon*ist.

In computer games, the issue gains a level of complexity. Most computer games begin by contextualizing the game-play within a story world. Characters are created, motivations are given,

and game-play is spaced between narrative elements. A game might begin with narration that sets the feel of the world, explains who you are, and gives you a goal, or reason to play. Narrative elements serve to draw the player in, divide different types of game-play and signal when the game has been mastered. On one level, game-play is motivated by the reasons given within the game story.

And so computer games appear to have two narratives: the game story and the metanarrative of the player's progress. But in reality, good games merge those two narratives. While the game sets up the motivation, characters, and story arc, the players are still responsible for telling the story through the way they play the game. If all stories invite us to identify with the protagonist, games are particularly effective in blurring the line between audience (player) and protagonist. Players both identify with, and are the protagonist.

Learning games can use the dual nature of game narrative to great advantage. The more closely the game narrative mirrors the intellectual challenge of the game, the greater the player's investment in the learning that is offered. For example, a game that models scientific thinking can be set in an environmental or medical crisis. A game about historical reasoning can be presented as a mystery story with the player acting as historian and detective. The player can simultaneously experience the pleasure of mastering the game and the subject matter.

The challenge in this is to truly integrate the story and learning. Too many learning games pose a narrative that is periodically interrupted with "educational" drills that must be accomplished before the story can resume. While some players may take pleasure in mastering those drills, such games never achieve the same emotional depth as those with unified game narratives and game activities.

In developing the narrative of a learning game, designers should also leverage what they know about their target audience. While any good narrative will appeal to a wide audience, the creator of a learning game has the opportunity to structure narrative that is particularly appropriate for the intended players. For example, in a game targeted at young players, the designer knows that children are engaged in developing their own identity, and exploring their relationship to the adult world. Accordingly, the designer should create characters and situations that reflect the narrative of children's lives. This doesn't mean that stories can't be imaginative and fanciful, or that they must necessarily be about the target audience, but the game promises to be more effective if the protagonist's stance in the world is similar to that of the player, or if the narrative reflects the player's hopes and fears.

IV. Synthesis

The same Greeks who gave us the idea of Agon also gave us the idea of dramatic unity.
In Greek drama, unity meant stories that were distilled down to the concise actions of a small number of actors in a single time and place. We believe that unity is a meaningful idea in our three elements—activity, structure, and narrative—though we apply it differently from the Greeks.

Unity of activities: game activities should engage the player in the kind of reasoning we want them to exhibit in the pursuit of their academic studies. Game activities should capitalize on the pleasure that players feel when working hard to beat a game, and enable the player to experience pleasure in learning.

Unity of structure: games should acknowledge that failure and success are not mutually exclusive states, but rather that success only come through the accumulation of insights that are themselves derived from small "failures." Accordingly, the game should find ways of rewarding effort while still placing a premium value on success.

Unity of narrative: game narratives should situate the learning in worlds that embody the content in meaningful ways. Narrative should also speak to the players' place in the world, and leverage their aspirations for mastery to inspire greater involvement and effort in the challenges the game offers.