Preparing Instructional Designers for Game-Based Learning: Part 1

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Abstract

Like many rapidly growing industries, advances in video game technology are far outpacing research on its design and effectiveness. Relatively little is understood about how to apply what we know about teaching and learning to optimize game-based learning. For the most part, instructional designers know little about game development and video game developers may know little about training, education and instructional design. In this three part series of articles, four recognized and emerging experts in instructional game design discuss their perspectives on preparing instructional designers to optimize game-based learning. In Part I, we set the context for the series of articles and one of four faculty members who teach a graduate level course on game design discusses what he believes instructional designers should know about instructional game design based on his experiences. Part II will present alternative perspectives from two additional faculty members who teach courses in instructional game design, and Part III will present a fourth perspective along with conclusion that compares the four views.

Keywords: Game-Based Learning; Educational Games; Instructional Design, Instructional Game Design

Instructional computer games, also known as "serious" and "educational" [video] games, have reemerged as an important outgrowth of the video game industry. An increasing number of commercial video games (e.g., Civilization, The SIMS, Zoo Tycoon) are being repurposed for use in schools and universities across the country, and the number of games being designed specifically to facilitate learning in conventional, hybrid and totally online training and education settings is also on the rise. The problem is, like many rapidly growing industries, advances in video game technology are far outpacing research on its design and effectiveness. Relatively little is understood about how to apply what we know about teaching and learning to optimize game-based learning. For the most part, instructional designers know little about game development and video game developers may know little about training, education and instructional design. As a result, instructional designers may not realize the potential of play, game, and story to create engaging and memorable learning experiences, and game developers may fail to apply basic pedagogical principles that are vital for facilitating learning.

Instructional designers can play a vital role in the instructional game development

process. Expert instructional designers apply extensive knowledge of pedagogy (broadly defined as the science of teaching and learning) and emerging technologies in a systematic fashion to optimize learning. Herein lies the challenge: Designers must have in-depth knowledge of emerging technologies (video games in this case) to effectively communicate and work with a team of professionals who may or may not value the designer's knowledge and background.

It may be too early to prescribe an explicit set of competencies for designing instructional games and facilitating game-based learning. Variance may actually be preferred at this time as we continue to explore, experiment with, and refine alternative approaches to instructional game design. We are just beginning to learn how to harness the power of video game technology to facilitate learning. However, it is not too early to compare experiences and share ideas on what we believe instructional designers should know about instructional game design to guide future practice and research.

This article represents Part I of a three part series that will offer four perspectives on preparing instructional designers to analyze, design, develop, implement and evaluate instructional (video) games. Part II will present two additional perspectives and Part III will present a fourth perspective as well as conclude with a brief comparison of views.

Throughout the three part series, we will discuss what we believe instructional designers should know about instructional game design based on our experiences working with game developers, teaching courses on game design, providing workshops on game-based learning, and actually designing instructional games. For the series of articles, we define an instructional game as an interactive, digital game (e.g., adventure, strategy, role-play, action, and massive multiplayer online games) that is designed specifically to facilitate learning. An instructional game may or may not include simulations, but neither includes multiple choice questions that have been simply transformed into an electronic "game show" nor popular board and card games that have been ported to a digital format. We limit our discussion to digital games to focus each author's writing and to facilitate comparisons across authors. The article is written primarily for practicing and potential instructional designers, and professionals who educate or otherwise train practicing and potential instructional designers. Educators in K12, higher education, and corporate and military settings, as well as game developers interested in the design of instructional games may also benefit.

Game Design as an Instructional Design Process

Richard Van Eck

"Whenever you add an instructional designer, they suck the fun out"

—Marc Prensky, DoE NCLB eLearning Summit, July 2004

This infamous quote always draws a chuckle from the audience, myself included, because it symbolizes the experiences we have all had with boring instruction in general and with edutainment (software that attempts to tap the power of interactivity and multimedia for learning) in particular.

But while there is a kernel of truth at the heart of this quote, it ignores the complexity involved with understanding how games and learning *do* go together. The humor (and the truth it is founded on) relies on two fundamental misconceptions about games and instructional design (ID). First, because games are about fun and entertainment, they are fundamentally incompatible with learning (actually, there are a third and fourth misconception implied here, which is that learning cannot be fun, and that games cannot be hard work, both of which are untrue). In fact, commercial games are instructional—one does not take a course on how to solve the challenges in a game, nor must one have played a previous game in order to be successful in a given commercial game. Second, that ID is sequential, linear, lock-step, and prescriptive. These misconceptions, I believe, arises partly from our own inability to convey the field to others, which leaves only our tools and models as outward displays of instructional design. Yet our tools and models are the distilled outcomes of a complex analysis of the internal and external conditions of learning; not a prescriptive process, but a set of heuristics that rely on a deep conceptual understanding of learning theory and the instructional process. The value in ID tools and processes lies in their use as heuristics that can guide the development of effective learning environments, not as recipes or procedural job aids that inevitably lead to high quality instruction. As such, they are dependent on creativity and artistry as much as on principles of cognitive science and education. Put another way, it is not that ID tools and processes by themselves constitute good instruction; it is that all good instruction comprises the principles and processes of ID. Given that ID principles arose from hundreds of years of study of learning theo-

ry and observation of master teachers, and given that games are successful in teaching a tremendous amount of previously unknown content without recourse to direct instruction outside the game (e.g., Gee, 2003), it follows that either games have stumbled upon an entirely unknown model of learning never seen in the history of humankind, or they are tapping the same learning mechanisms and strategies that have worked for humans since the dawn of time. Occam's razor would suggest the latter.

In this section, I discuss how commercial games, as instructional media in their own right, embed some of the principles of good ID practice. I also spend some time discussing how ID principles are modified by the medium of games, and what this implies for instructional designers as we struggle to tap this powerful medium to build instructional games. Obviously, space does not permit a full description or analysis of ID as a field, let alone how it applies to game design. Nor is it my claim to have developed a full model that integrates instructional design with game design. This is a new field that can only be fully established through emergent design and research. That does not mean, however, that we cannot borrow from existing theory and practice, and it is my hope that by describing some of the tenets of ID as I see them implemented in games, we can see how these fields complement each other and begin to establish a framework for how to better blend them.

In this section, I refer to commercial games as any digital game sold primarily for entertainment. As such, they may run on computers or video game consoles, and while all do have learning outcomes (e.g., to learn to fire weapons, outwit opponents, solve mysteries and puzzles, etc.) these are usually not explicit, not design to address curriculum goals, and in any case are not the purpose for which the games are made or purchased.

In addition, when I refer to ID, I refer to it as a largely heuristic process of ID (e.g., Analysis, Design, Development, Implementation, and Evaluation, or ADDIE) as well as in the larger sense of learning theory within which ID is situated. Finally, I use the term instructional games to mean any interactive, digital game that is designed specifically to facilitate the achievement of a specified set of learning outcomes that meet educational goals. Some prefer the more popular term "serious games." This label is useful for describing game-based learning to those outside the field, including the mainstream press, although some have argued persuasively that the term "serious" perpetuates the stereotype that play is frivolous (i.e., not serious) and therefore that most games are guilty by association. I would add to this drawback that the largest body of work commonly referred to as serious games often focus as much on humanitarian, social, and political themes as they do on specific instructional objectives that serve formal educational goals. These serious games are important, and are indeed instructional, but to avoid any potential confusion over meaning, I use the less connotative term instructional games here. Likewise, I use instructional as opposed to educational to reflect distinction between our macro-level educational goals (what we want out of our educational system) and the micro-level instructional goals and objective (what we want out of a course, curriculum, module, etc.).

"For the most part, instructional designers know little about game development and video game developers may know little about training, education and instructional design."

These are the games that we educators and instructional designers build from the ground up. If instructional designers are to develop successful instructional games, we must first understand how learning and instructional design are manifested in commercial games, and must secondly modify our instructional design practices (if not our models) to design games that are both instructionally effective and as engaging as commercial games. We begin, then, with an analysis of some principles of learning theory as they appear in commercial games.

Core Principles from Cognitive Science

I believe that much of how and why games are effective learning tools can be understood through the lenses of multiple disciplines and theories, including cognitive science (e.g., Piaget, narrative theory, play theory), education, art, and psychology (Van Eck, 2007). I first encountered this multidisciplinary perspective in understanding games in Lloyd Rieber's (1996) article "Seriously Considering Play" in ETR&D. I consider this to be required reading for those new to game-based learning, and it has been required reading in my game-based learner classes ever since. For example, Piaget's concept of cognitive disequilibrium, the state of mind when a learner is confronted with new information that must be accommodated by modification of existing schemata, describes

perfectly the experience game players have on a regular basis as the game foils expectations. It is this process that leads to question-asking, which is thought to be a key to learning and promotes engagement. Likewise, Vygotsky's concept of scaffolding describes perfectly the process commercial game-designers use to help players with a wide range of expertise manage game complexity—challenge is optimized and support (scaffolding) is adapted to provide just the right amount of assistance during a game to allow for success without giving the answer away. Instructional designers interested in game-based learning must be familiar with the full range of this relevant literature. Elsewhere (Van Eck, 2006), I have proposed four principles of game-based learning prompted by my experiences as a game player, researcher, and designer over the last 20 years: (a) games employ play theory, cycles of learning, and engagement, (b) games employ problem-based learning, (c) games embody situated cognition and learning, and (d) games promote engagement through cognitive disequilibrium, question-asking, and scaffolding (this fourth principle is slightly modified from the original. Space does not permit a full description of these principles and the research and theory they are based on, and readers are referred to the original text for a full treatment. A short example of how games embody problem-solving may help to illustrate my point, however.

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According to Jonassen (2002), problem solving has at its heart a goal; the fact that we do not know how to achieve the goal without generating new knowledge is what makes it a problem. The knowledge we must generate to solve the problem is what Jonassen refers to as the *unknown*. The second component to problem solving is that there is some kind of *value* to the problem-solver inherent in finding a solution to the problem. Reading the back of just about any commercial video game shows us how games meet both components of this definition. Consider the following from a former Game of the Year Award winner, *The Longest Journey*:

> Between science and magic, between order and chaos, between Stark and Arcadia, there is an ancient balance. For thousands of years, this balance has weighted the scales of the cosmos evenly, ensuring harmony between the twin worlds. But now, in an age of great turmoil, chaos threatens to turn the scales and bring our most terrifying dreams to life. The Guardian of the balance has abandoned his throne... the armies of the Vanguard are advancing... a storm is coming... and the fate of the worlds is in the hands of one person: April, a Shifter. April's future is shrouded in a veil of mystery, and the journey ahead is treacherous and winding. A journey not only through twin worlds, but into her own heart and soul.

The goal of this game is to restore balance to the universe, thwart the armies of the Vanguard and avert the coming storm. We will accomplish this by figuring out who April is, what a shifter does, and by taking a treacherous and winding journey through two worlds and her "heart and soul". While the goal is clear, the means of achieving it are not, and are what constitute the "unknown." The value in generating this new knowledge in order to solve this problem is evident from the interest the reader feels when reading this passage, which in the case of this game translated to 10,873 people who took this challenge on voluntarily and at a cost of $50 in the first month of its release, and the more than 50,000 the next year people who did the same.

Gagné, Wager, Golas, and Keller (2005) also describe the conditions of learning needed for problem solving as performance that "requires the invention and use of a complex rule to achieve the solution of a problem novel to the individual. When the higher order rule has been generated, it should also be possible for the learner to demonstrate its use in other physically different but formally similar situations" (p. 73). Now consider the following scenario from the commercial game *Mysterious Island*. I am stranded on an island with only a few items, including a satellite phone with a built-in encyclopedia. The phone is out of power and I do not have access to electricity. I know that my phone needs power to work and that an outlet is needed to charge it (prerequisite rules). I also know that I have an inventory with some items in it and, if I have played any game before, I know that things I have found will be useful in some way during the game (cognitive strategy and a rule). Later, in a laboratory in a cave, I find notes from a previous island resident (as scientist) on how to build a battery out of common objects, some of which I have already located on the island. Rather than recharging the battery I have, I have found a way to replace that battery. I combine the required objects in my inventory by dragging and dropping

them onto each other to build a battery that provides minimal power (enough to activate the encyclopedia on my phone, which will help me solve other problems in the game). I have combined several rules in the game, some of which I knew (phones and batteries) and some of which I had to learn (how to make a battery, alternate ways to power my phone, and how to combine things in inventory). These rules have helped me formulate a new complex rule/cognitive strategy: information can be found (on the island or in my phone) that can help guide me as I combine useless things into things that will help me solve problems. This will help me later in the game (many times).

Of course, problem solving itself is far more complex than can be conveyed here. There are at least eleven different kinds of problems with different cognitive requirements, and the ways these interact with different kinds of games and gameplay is another topic entirely (e.g., Hung & Van Eck, 2010). But these two short examples of the second principle I listed earlier serve to illustrate in part how games already employ effective principles and theories of learning. Far from sucking the fun out by virtue of their very presence, these principles are in fact an integral component of commercial games already. As such, they actually promote, rather than negate, engagement. Commercial games succeed in this because those principles are thematically and contextually embedded in the game rather than used in a laundry list, lock-step fashion. In searching for ways to promote engagement, the commercial game designer often employs PBL, whether they realize it or not. But they do so in ways that promote what Czikszentmihalyi (1990) calls "flow," by embedding these strategies and principles of learning in a meaningful context that does not require access to outside resources or interrupt the game narrative. Anytime players have to "surface" because of a lack of information or support within the game is an interruption of game flow. This is key for instructional designers who want to design instructional games; any PBL process or content must be encapsulated *both* within the game itself *and* the game narrative. Games with challenges that cannot possibly be solved without recourse to outside information (what I call the "10 Little Indians" phenomenon, after Agatha Christie's book of the same title in which it turns out that the murderer is actually the first victim in the book, for whom no clues existed regarding his death being anything but factual), or which violate these principles in other ways will in all likelihood not be as successful as their counterparts.

It is worth repeating here: all good instruction makes use of ID principles, and the application of ID principles results in effective instruction. It is also true that applying ID principles as a recipe of steps without regard to the medium, content, or learners (as many outside ID believe we do) will result in bad instruction, Game design and instructional design are both much more than literal recipes, and ID can play a valuable role in instructional game design without destroying what makes games engaging. Part of the challenge in this is that commercial games are immersive learning environments, and most instructional designers were trained to develop for less immersive mediums (e.g., print, video, facilitator-led). The good news is that, at its heart, instructional design is the arrangement of instructional resources to generate environments that facilitate learning—the very skill needed to develop game-based learning, if we take the time to understand this new medium.

Learning Taxonomies and Game Ontologies, Oh My!

There are dozens of types, or genres, of digital games, each with its own unique characteristics. Just as card games, board games, and digital games vary widely in their conventions and processes, so can digital games be subdivided by type (e.g., first-person shooter; adventure; strategy; massively multiplayer online role-playing games, or MMORPGs), each again with its own strategies and characteristics. Although they can be combined within and single game, commercial game designers know that each genre has its own strategies that will appeal to different players. Those who tend to play first person shooters (FPS) like *Gun* or *Max Payne* are less likely to purchase good sims like *Civilization* or *Spore*, because they prefer the skills and strategies of FPSs. Just as game genres support different play strategies, it seems logical to expect these genres to support different instructional principles and approaches. An arcade–style game emphasizes strategies such as speed of response, hand–eye coordination, and visual and auditory discrimination. As such, it is reasonable to expect that it might be best for automaticity and fluency training, or training for performance under stressful conditions. Miller and Heward (1992) suggest, for example, that challenge and competition should be increased once the learner begins to make more correct than incorrect responses, but is contraindicated prior to that level of achievement.

Likewise, a card game might be expected to more easily support learning that emphasizes pattern matching with numbers, while an online multiplayer role-playing game might more easily support social learning strategies

and outcomes, discovery-based learning and problem solving with its attendant goal setting. This is not to say that game genres can only support certain learning outcomes—it is certainly possible for a card game to support complex problem-solving (e.g., *Yu-Gi-Oh*) just as it is possible for any medium to support any learning. But just as we recognize that computer-based instructional simulations may not be the best medium for unstable content, or that tutorials are not the best way to support problem-solving, we should adopt the same critical stance toward games, and not expect a *Jeopardy* game to be the best means of learning to solve ill-defined complex problems. So if (as I believe), an adventure game tends to emphasize evaluation, hypothesis testing, and reflection, while an MMORPG requires the same skills but within a social context of negotiation, leadership, communication, and shared goal setting, it follows that I should take this into account when designing a serious game for outcomes that are closer to one than the other.

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But it is also important for instructional designers not to mistake the trees for the forest when moving into instructional game design. While goals and outcomes *are* important to commercial game designers, they are secondary to the gameplay itself (e.g., Koster, 2005). Instructional designers tend to hold goals and outcomes sacrosanct, developing and modifying objectives accordingly. To a commercial game designer, however, who is willing to sacrifice veracity and coherence of the narrative if needed for engaging gameplay, this may sound like putting the cart before the horse. When developing instructional games, we cannot allow the goals and objectives to trump gameplay, nor can we sacrifice learning goals for the sake of playability. But these are more like anchor points on intersecting continua (instructional goals & objectives and game goals and objective) than diametrically opposed concepts. Ignoring the desired learning outcome is what leads to the misspecification of assessments and the use of inappropriate instructional strategies—the very things "traditional" education is disparaged for doing and which game-based learning is lauded for avoiding. The key lies in finding ways to incorporate gameplay into our objectives, and effective learning into gameplay design. If and when a game is No Fun, there are a number of different ways to address it. Game designers find the fastest, most effective way to address the problem *without* any goal, objective, or veracity constraints. Adding constraints based on veracity and learning efficacy will undoubtedly result in *different* solutions, which may in fact take longer to arrive at and design for, but they need not result in games that are No Fun. The presence of an instructional goal does not mean that the game must state the outcome or purpose explicitly to the player. Commercial games communicate the goal to the player without doing this, after all. Rather, we have to align the desired *learning* outcomes with the *game* outcomes, and align both of those with the *strategies* employed to facilitate learning and *engagement* during game play.

For example, a good commercial game designer does not ask the player to solve word puzzles if the goal of the game is to infiltrate a Soviet spy agency. Likewise, and a good instructional designer does not use word puzzles to teach problem-solving. They key is to find ways to address learning outcomes while preserving the malleability needed to design for gameplay at the same time.

Where we cannot find a perfect merging of gameplay and learning outcomes, we can still find ways to achieve both. For instance, we can allow for multiple strategies and challenges during the game, SOME of which are related to the learning outcomes and some of which are purely for play. There is more than enough room and creativity for game designers and instructional designers to co-exist in this process, but both sides must understand the other's perspective. Commercial game designers can make fun games in many genres, so it should not pose a problem if the instructional designer proposes the genre that will best support the learning outcomes desired.

Gagné's Nine Events

Another example from ID that can help inform the design of instructional games lies in Gagné's (1965) nine events of instruction (See Table 1). Once again, those outside ID often look at these events as a sequential laundry list, but good instructional designers know that these events are recursive and may vary in frequency and sequence throughout the instruction. Gagné

specified only that all nine events *are* present in effective instruction, *not* how often they occur, or whether they occur in a rigid, linear sequence. One strives to gain attention (the first of the nine events) only when it is expected that the learner may not be attending to the content at the level desired. The false assumption held by those outside ID is that gaining attention is accomplished by addressing the learner directly ("Hey! Wake up in the back row!"), rather than by the use of humor, juxtaposition of seemingly contradictory ideas, type-face, etc. Some point to games as an example of why the nine events are not necessary: game players are always paying attention without being told to do so. Closer inspection, however, reveals that games do in fact employ tactics for gaining attention but that the context of the game makes this less obvious.

Games gain attention through cut scenes, animations, music, sound effects, perceived threat, timing, and a whole host of other events working together. Feedback is constant and almost never delayed; push on a locked door and your character is likely to respond "It's locked!" Game design, because it relies on story and narrative and incorporates image, animation, and sound may be at its heart a creative, artistic endeavor. For expert instructional designers, the ID process itself is largely intuitive and, therefore, the act of design is also an artistic process. I do not believe that one must choose art over science when designing instruction—ID is both an art and a science when done right. In fact, I argue at great length about the importance of narrative and story for game design elsewhere (Van Eck, 2006). Consider the following narrative taken from the first five minutes of gameplay of the game *Gabriel Knight II: The Beast Within*, punctuated by labels for some of each of the nine events of instruction:

The game opens with slow video pan of Knight sitting at his desk writing his latest novel. His assistant enters the room and tells him there are visitors at the door, even though it is midnight (gain attention). Upon opening the door he sees villagers with torches (gain attention), who inform him that there has been a killing, and since he is the Schattenjaeger (a designation earned in the previous game—recall of prior knowledge) he must investigate. The police think it is wolves from the zoo, but the villagers think it is a werewolf, so he must determine which is correct (inform of objective). He wakes up the next day in the farmhouse where the killing happened. Exploring, he finds a letter, and knife, and a tape recorder, which he thinks "may come in handy" (provide guidance/feedback). Throughout this process, clicking on things either produces no result or changes the cursor to indicate an object that can be examined or interacted with (provide feedback). He also reads a newspaper that describe the killings, the name of the police chief, the name of the zoo, and the location of both (present instruction). Exploring the farm outside (provide practice) turns up fur and a paw print, but he remarks that there is no way to pick up the paw print (provide guidance). He finds quick-drying cement and combines it with water, pours it into the print, then picks the casting up (provide practice). He can now use the keys to drive the car to town where he can interview the police chief and the zoo director. *If* he has done these things in order, he will learn more about each (provide instruction/provide practice), but if not he will get the brush-off (assess performance). In each case, things that he picks up, combines, and uses from inventory (e.g., the tape recorder for recording conversations or the metro map for travelling to different locations) lead to success and establish their future use in the game (enhance retention and transfer).

See Table 1 on the following page for the rest of the nine events and some of the ways they are used in commercial games.

For those who are starting out in ID, heuristics such as the nine events can be an invaluable tool to support their design. The problem is, of course, that novices sometimes rely too much on prescription and implement the steps in an instructivist, literal fashion. It is not uncommon to find during formative evaluation that learners are not attending (or not attending correctly) to some part of our instruction, are not able to interpret feedback or elements of the instruction correctly, or are mis-judging their own knowledge in making choices about learner control within the instruction. Where and when this happens, we might strive to draw or guide (gain) their attention to a specific part of the instructional message, provide additional guidance to help them interpret feedback or instruction more accurately, or build in additional practice or assessment with feedback to ensure they know what they know and do not know. Commercial game designers encounter similar issues during development, and thus require similar adjustments, whether the game designer consciously uses the nine events as an heuristic or not. At these times, I would argue, it is more important that these adjustments be contextually sensitive to the game world and that when we gain attention, for instance, we do so by character voice inflection, environmental cues (as in when certain sounds play in *Neverwinter Nights* as we come across significant objects), tools within the game (e.g., journal entries that contain essential elements of our

Nine Events	Examples of Nine Events from Games
Gain Attention	Motion, cut scenes, noise, music, character speech, health meters, attacks, death
Inform of Objective	Back of the game box, documentation for the game, introductory movies, cut scenes, character speech, and obstacles that limit movement or interaction
Recall Prior Knowledge	Environmental cues (e.g., in Laura Croft: Tomb Raider, ledges that look like those trained on in the earlier tutorial), obstacles (search for solutions involves recalling solutions and events from earlier in the game)
Present Instruction	All of the above (characters, environment, objects, puzzles and obstacles, conversation) arranged according to goals of game; games employ situated learning and guided discovery strategies to embed learning in the context of the narrative.
Provide Guidance	Cut scenes, non-player character (NPC) or player character (PC) speech, hint books, cheats and walkthroughs, friends, partial solutions to puzzles (pressing on the wall makes it rumble, but it does not open; NPCs or PC says "I don't think there is time to check that out—we need to find that map!"); The arrangement of the actors and objects in the environment and the structure of the story itself also provide implicit guidance.
Provide Practice	Players practice and refine skills and knowledge needed to advance; mastery of challenges usually requires multiple attempts.
Provide Feedback	Character speech, sounds, motion, etc.; mastery of challenges followed by game advancement, cut scenes, new information, etc. Every action has immediate feedback, even if that feedback is that nothing happens.
Assess Performance	Advancement through the game IS assessment; players learn skills in order to overcome challenges, each of which represents assessment of those skills
Enhance Retention & Transfer	Things learned early in games are brought back in different, often more complex forms later (e.g., jumping and running are combined for a power jump to cross larger obstacles). Players know that what they learn in the game will be relevant in both the short and long term.

Table 1. Nine events of instruction in games.

conversations with characters) or other visual cues (e.g., bold typeface or differently colored text in the text bubble).

The Instructional Design Process

One strength of the instructional design process is that it ensures that desired outcomes lead to explicit, measurable objectives, which are, in turn, aligned with assessment. The specification of measurable objectives, and subsequent alignment of learner assessments, is also key to the development of instructional games. The fear many commercial game designers have is that instructional designers will insist on specifying the objectives as direct verbal instruction directed at the learner(!), and then give them a multiple-choice test at the end of the game! Obviously, we have to know how outcomes and objectives are presented in games (the description on the box, in the manual, information delivered by characters in the game, etc.), and then in turn define and present them within the game world context.

I have already argued that commercial game design and instructional design share the same basic approach, if for different outcomes and purposes. In fact, the ADDIE process (analysis, design, development, implementation, and evaluation) that underlies the many ID models today explains the process used in commercial games design and in fact in many other professions like architecture (blueprints and design specifications that incorporate client needs, environmental constraints, functionality) and performance improvement (problem analysis, systems thinking, desired vs. current performance, intervention selection, evaluation). It is difficult to build something if one does not know what it should do, how it should do it, and how to tell if it works. There is a reason that Rapid Prototyping (Tripp and Bichelmeyer, 1990) is a model shared by both

instructional design and the software development industry. However, while the same process may underlie these disparate professions, it does not mean that the implementation of this process is identical; different products require different applications of each phase. A full description of the ADDIE process as it exists within commercial game design is not possible, but a discussion of some of the phases and their manifestation in the commercial or instructional game design venue will illustrate my point.

Analysis. While a game designer begins with a concept or idea and is guided as much by intuition and artistry as anything else, and an instructional designer begins with a specified content area/skill set that does not change, both quickly find themselves at the same juncture. Both strive to establish what the overall goal of the product will be and to specify how that goal will be achieved by the player/learner. Both consider their audience (player vs. learner characteristics), the environments (gaming platform vs. learning context), and prior knowledge (games they have played before vs. prior learning), as they specify and refine their goals.

One aspect of analysis that affects IG design is the issue of fidelity. How real should a game be, and how realistic should the graphics and audio be? The debate about the role of graphics and audio in engagement is one that ID has been exploring through research over the last 30 years. I do not want to resurrect *Kozma v. Clark* again (see Clark, 1994, and Kozma,, 1994), but suffice it to say that in my opinion, the media *by themselves* do not make any difference—it is the ways in which they are employed (the instructional design) that has the largest impact on efficacy. Likewise, some games have lower production values but are highly engaging (look at the *Nintendo DS Lite* or *Wii*), while others have extremely high production values and are a commercial failure because the game play is lacking.

Many mistakenly believe that a game must look and feel as close to "real" as possible to be effective. In actuality, games must only be good enough to suspend disbelief. And sometimes verisimilitude is contraindicated. For example, flight simulators must be simplified (made less "real") for novices to partition their attention effectively to master the basics of flight and then are gradually increased in complexity (made more "real") as the learner progresses. This is exactly what many commercial games do; they allow the learner to master basic moves before progressing to higher levels that require those moves in combination with others. The key to fidelity is what Thorndike and Woodworth (1901) called identical elements (thanks to John V. Dempsey for first suggesting this idea to me in relation to the design of simulations and computer-based instruction): the perceived similarity between the learning and performance contexts. So, what matters is the interaction amongst the learning and performance contexts, the nature of the task, the complexity of the learning, and the expertise of the learner at any given stage. There is a significant body of research on this over the last 50+ years (e.g., Osgood, 1949; Gick & Holyoak, 1980; CTGV, 1992) and related ideas like seductive detail (when the complexity of the environment, although interesting, interferes with processing of relevant information) vs. relevant distractors. Instructional designers considering game-based learning must be well-read in this literature to avoid repeating the mistakes of the past.

Design. Once the overall goal of the game or instruction has been articulated, both game designers and instructional designers begin the process of mapping out scope and structure of the product. For game designers, this means mapping out side quests, obstacles, challenges, and puzzles and setting conditions for progress and mastery. For instructional designers, it means developing Learning Task Maps that specify enabling and prerequisite skills needed to achieve the overall goal. From these same processes, both game designers and instructional designers then specify the context, behavior, and criteria for mastery of each challenge/skill. To be sure, ID objectives look different and are much more specific than their counterparts in game design, but they serve the same purpose. Games present multiple challenges and puzzles (objectives) to the player as he or she attempts to win the game (the goal), but the relationship of the objectives to the goal is more fluid than it is for instructional designers. For example, if game designers want to develop a challenge that is not directly related to the goal, per se, they are free to do so, which is not something the instructional designers often do. As with instructional design, objectives in commercial games are clear to the learner at most points throughout a games, but not because the game articulates the objectives as verbal information. Rather, the objectives are implied by the situation and the narrative. When the player encounters a locked door, the implied objective is to find a way to open the door (the ambiguity comes in when some avenues are dead-ends, meaning not all objectives are relevant to the goal). When a non-player character (NPC, or a character controlled by the game) says she would like to help out but she is too busy doing other things, the implied objective is to re-

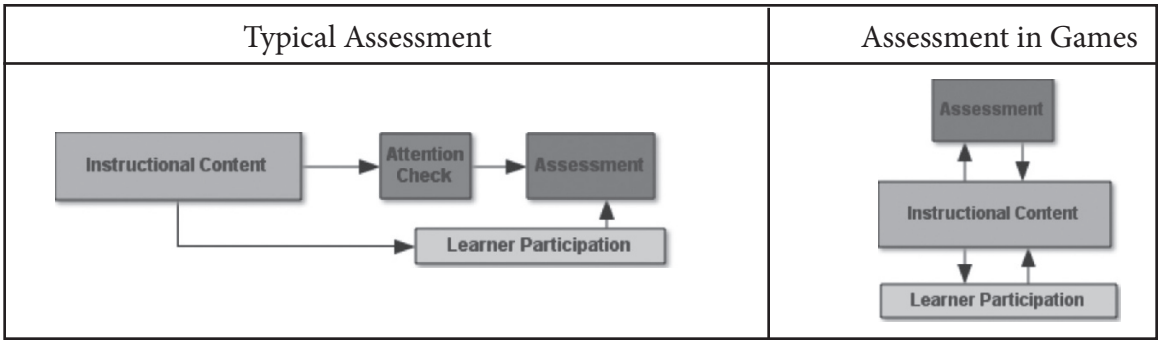

Figure 1. "Typical" Assessment and Interaction vs. Assessment in Games

turn later or find a way to reduce her workload. Just as the learning in games is always situated, so must the objectives be grounded in the game narrative.

Assessment is another instructional design concept that appears within game design and evaluation, but takes on a very different form that typical instruction. The situated nature of learning in games dictates that assessment happens continuously within the narrative context of the game as both short-term (solve the challenge and get past the obstacle) and long-term (solve all the challenges and achieve the game goal) goals. Assessment in games happens as part of the story, and performance is not communicated as it is in the educational system ("you got 80% on that test") but through "real-world" consequences (the locked door opens; the game character provides more information; you move on to the next level of the game). Instructional designers must understand the difference between "typical" assessment and assessment as it occurs in games (Figure 1). Just as learning theory is contextually cognizant of the game, so must our assessments and, therefore, our objectives also take the game context into account. We will have to design new forms of assessment and objectives accordingly, including objectives for measuring engagement and fun. For example, see Sebastian Loh's chapter on assessment and audit trails in game worlds in Gibson, Aldrich, & Prensky's *Games and Simulations in Online Learning: Research and Development Frameworks,* (2006).

Formative Evaluation. In the interests of space and because they are somewhat self-explanatory, I will skip over Development and Implementation and go directly to evaluation. The process of formative evaluation we employ in ID is also found in commercial game design. In particular, one-to-one and small group evaluations are consistent with the processes game designers use (play testing, beta-testers, etc.). For example, if, during play testing (formative evaluation) commercial game designers find that most players are not seeing a key item in the game or are overlooking an element of the interface that is necessary for solving one or more challenges, the designers find a way to highlight that element (gain attention/provide guidance) through NPC intervention, increasing the contrast of the item, or providing a hint in the FAQ section of their website. If game designers find that most players don't know what to do next at a certain juncture of the game, they find a way to tell them (inform of objective/provide guidance/provide feedback), albeit indirectly, and within the context of the game narrative.

So, far from instructional design processes being somehow inimical to game design, we find that both game designers and instructional designers are engaged in the same things. Both are, after all, developing learning environments. The difference lies in form these processes take, and the things that we measure, which means that each discipline must understand the constraints and needs of the other and modify their practice accordingly. For example, when it comes to evaluation, game designers need to understand that evaluation in an instructional game must also include evaluation of the learning, which may require modification of challenges. What instructional designers need to understand is that evaluation must also include game play, which may require modification of strategies, sequence of learning, and the development of challenges and strategies that extend beyond the attainment of instructional objectives.

Conclusion

These are some of the areas and ideas that instructional designers can contribute to the design of game-based learning. There are many other areas like Malone and Lepper's (1987) Theory of Intrinsic Motivation, cognitive load, engagement, artificial intelligence, and narrative psychology which are required for a solid foundation from which to design instructional games

(e.g., Van Eck, 2006 & 2007). Far from being a medium with a new set of learning theories, games are effective teaching tools because they employ the same theories and principles as all successful learning. The key lies in understanding how the medium modifies the way our theories and princ s to be consistent with this new medium. Instructional game design will require the integration of many fields of thought and many different perspectives without privileging any one over another. It is a delicate dance between art and science, between instructional design and game design, and between play and guided discovery. It is a dance in which we must at times lead and at others follow if we are to play a part in shaping this emerging medium.

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