Chapter ?
A Guide to Integrating COTS Games into Your Classroom

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ABSTRACT

Many of the educational outcomes we seek to promote in public education, such as problem solving and critical thinking, are difficult to achieve given the constraints of the real-world classroom. Commercial Off-the-Shelf (COTS) games make excellent tools for addressing both content-based and higher-order learning outcomes, and many educators are exploring their use in the classroom. But making effective use of commercial games in the classroom requires that we understand how games function in relation to the typical instructional strategies and practices of the classroom. The first part of this chapter will examine the theories that underlie the successful integration of commercial games in the classroom and look at an empirically based model, the NTeQ (iNtegrating Technology through inQuiry), for designing lessons that integrate COTS games. This will lay the groundwork for the second part of the chapter in which these theories and the model are discussed in the context of actually designing COTS game-based learning (GBL).

PART I: THEORETICAL FOUNDATIONS FOR DESIGNING COTS GBL

Introduction

Despite the growing interest in using games as learning tools in public education, very few games are designed for the classroom. Those that are (e.g., the *Leapster*® and *Learning Company*® products) often tend more toward learning tutorials than learning games, and are thus difficult to integrate within the existing curriculum except as additional practice in subject areas. Such software can play a valuable role in learning, and students no doubt enjoy them more than they enjoy reading a textbook, but this does not capture the true power of games to engage (in the cognitive *and*

entertainment sense of the word). There are many reasons for the dearth of truly engaging games for the classroom, of course, including school infrastructure and policies that lock down labs and networks for security reasons, the difficulty of designing games without the resources of a large development company, and the attitudes of the parents and administrators who view games with a healthy dose of skepticism.[1]

But one of the main reasons we do not see more educational games that look and feel like commercial games is that many designers do not understand how games integrate learning and content seamlessly throughout the game. From the outside, it seems as if games have no content because all we see is play. But it quickly becomes apparent to any who sit down to play them that many games are extremely difficult to play, requiring hours of practice to master. And yet it is through interaction with the game rather than texts, videos, or other media that this learning is achieved. Clearly, games themselves serve an instructional role, and they must be effective or the titles would not sell and the players would not spend upwards of 50 to 100 hours playing them without being forced to. Unless we are willing to accept that game developers have somehow stumbled on new learning and instructional theory, it stands to reason that the things we do know about effective instruction and learning are present in these games, if in modified form.

Why should we care? Because it turns out the in the same way that ignoring the theories behind how games teach has led to poor examples of learning games, so too will doing so lead to poor examples of COTS GBL.

The Use of Commercial Games

It should be noted up front that the games I am most interested in here are those that address higher-order intellectual skills like problem solving. While a great many games address problem solving in one fashion or another, adventure games (e.g., Myst), strategy games (e.g., *Civilization*), simulation games (e.g., *Sim City*), and modern action and first-person shooter games (e.g., *Halo*) tend to be extremely complex and require upwards of 50 to 100 hours to solve. While other games like card games and board games (e.g., Scrabble) have value in educational settings, they are much easier to adapt to learning environments and do not require much in the way of guidance.

Many are looking to commercial off-the-shelf (COTS) games for their potential integration within existing curriculum (Googling "COTS games in the classroom" yields nearly 200,000 hits on this topic).[2] The assumption behind this approach is that COTS games are developed by companies who know how to build effective, engaging, entertaining games; using them relieves teachers of the need to become game developers and programmers in order to use games in the classroom. Games that involve existing curriculum areas like math (e.g., the *Sim* and *Tycoon* titles), or history (e.g., *Civilization*), or science and physics (e.g., *Contraptions*), having already been vetted in the marketplace, will be good games.

These things are true, as far as they go, but we must also understand that it is not just the content that makes GBL a good idea in classrooms; it is what learners are *doing* with that content as they interact with the rest of the game. It turns out that the content is secondary to the critical reasoning, problem solving, and ways of processing information and negotiating, meaning they are integral features of many COTS games. And this is not just true of games; expert teachers know that you cannot teach problem solving as a set of abstract principles (e.g., Anderson, 1995), but must instead embed them within existing domains and professional ways of knowing (e.g., Shaeffer, 2006) and expose learners to many examples over long periods of time (e.g., Gick & Holyoak, 1980; Osgood, 1949; Rogoff & Gardner, 1984).

As much as we might wish it were so, it is not possible to take full advantage of the power of games by simply "adding extra content" to a

game. Developing lesson plans that truly take advantage of what games can do requires that we understand *how* games embed instructional strategies, objectives, assessment, and the other instructional elements that all effective instruction uses. We must understand how these theories and instructional elements work in games if we are to extend their use to the classroom. Designing effective COTS GBL is not a simple process, any more than designing any truly effective learning is easy.

In the next section, we will examine some of the most relevant theoretical and instructional principles that games employ and which govern the integration of games in the classroom. We will also examine how an established K-12 technology integration model, the NTeQ Model (Morrison & Lowther, 2005), can serve as a bridge between designing practical, effective lesson plans for the real-world classroom and the theories of learning and instruction as they exist within games. This model and process are the subject of the second half of this chapter, in which we examine the practical application of the NTeQ model to the analysis, design, and implementation of COTS lesson plans in the classroom.

Theoretical Background

There are three theories and instructional principles that are key to understanding both learning as it is supported by COTS games and the use of the NTeQ model for the development of lesson plans that integrate games: situated cognition and learning, intrinsic motivation, and objectives and assessment. These will be relied on later in this chapter as we examine the NTeQ model in more detail.

Situated Learning and Cognition

What It Is

The first theory that guides learning in games, and which must therefore also guide COTS GBL, is situated learning. This theory arises out of a movement in cognitive studies in the 1970s that began to study human cognition in the contexts in which they naturally occur (Cohen & Siegel, 1991; Graesser & Magliano, 1991; Meacham & Emont, 1989). Research has shown that knowledge and transfer are strongly tied to context and domain (e.g., Bransford, Franks, Vye, & Sherwood, 1989; Bransford, Sherwood, Vye, & Rieser, 1986; Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; Perkins & Salomon, 1989) and that learning is effective to the degree that it is embedded in a meaningful context (e.g., Choi, 1995; Choi & Hannafin, 1995).

What It Means for COTS GBL

There is nothing more important to COTS GBL than a conceptual understanding of this theory. Games convey the knowledge needed to meet the goal of the game and the many challenges along the way, *not* through direct instruction, but by embedding (situating) knowledge, feedback, guidance, and other instructional events within the context of the game. The fact that the game context may vary in its representation of "reality," from the fantastic to the real, does nothing to undercut the efficacy of this approach.

This means that the game world and context are the "real" world, *not* the classroom or even the professional environment in which the knowledge being generated will eventually be applied. All instructional events and content must be subservient to the game world to the extent that doing so is possible and does not violate the facts, concepts, and rules being learned. This theory is also important to understanding intrinsic motivation.

Intrinsic Motivation

What It Is

Malone (1981) and, later, Malone and Lepper (1987) proposed a theory of what they called intrinsic motivation (motivation that stems from internal events such as goals or affective responses rather than from external events such as rewards). Intrinsically motivated learning, then, is "learning that occurs in a situation in which the most narrowly defined activity from which the learning occurs would be done without any external reward or punishment" (Malone & Lepper, 1987, p. 229).

All successful games are intrinsically motivating, meaning the player wants to play them for their own sake. The four factors they proposed—challenge, curiosity, control, and fantasy—can be used to explain which games are intrinsically motivating. While all of these factors are important, the concept of fantasy is particularly crucial. Intrinsically motivating games align the content of the game (learning what is needed to solve the puzzles and challenges) with the fantasy (the game-play, context, and narrative of the game), which Malone and Lepper (1987) refer to as endogenous fantasy.

What It Means for COTS GBL

This is not much different, conceptually, from the idea of situated learning, and is key COTS GBL; all instructional activities (some of which must occur outside of the game itself, as we will see) must strive to extend the context of the game world (the fantasy) to the content that occurs outside the game itself (Rieber, 1996; Van Eck, 2006b). Content that is not tightly integrated with the fantasy context of the game will result in COTS GBL that is *not* intrinsically motivating.

Objectives and Assessment

These instructional elements are familiar to us, but are present in games differently than in more "typical" instruction. Just as was the case with intrinsic motivation, situated learning helps explain how objectives and assessment occur in games. It is good instructional practice to communicate objectives to the learner in order to support metacognitive processes and to activate or establish relevant schemas. In typical instruction, it is not uncommon to present the objectives verbally at the beginning of the instruction, and to administer a pre-test and post-test to assess learning. This, however, is antithetical to the nature of objectives and assessment in games. The purpose of a course is to learn; the purpose of a game is to play. Learners in the classroom are prepared (and expect) objectives and tests as part of accomplishing their learning goals; game players have different expectations, however.

What They Look Like in Games

Just as everything a player learns within a game is situated within the game context, the objectives and their performance (assessment) are also situated within the game context. Objectives are presented in a variety of ways: as part of the materials that accompany the game (the game box, manual, etc.), via characters in the game who communicate with the player at different points, and through cut-scenes (cinematic episodes at strategic points in the games such as between levels). But they are also communicated through other, non-verbal actions within the game, such as when the player enters a room in the game and is immediately attacked; although the player is not told what the objective is, it becomes clear that they must defeat whatever is attacking them. Indirect communication (situation) of objectives is the most common method of establishing objectives in a game.

Given the ways in which objectives are communicated in authentic, situated, embedded ways in games, it follows that assessment will mirror this process. This means that assessment is continual throughout the game (temporally and conceptually contiguous with the objectives) rather than occurring at the end,[3] and that the nature of the assessment always reflects both the fantasy of the game itself and the problem-based nature of learning in games (since all skills in games are learned in relation to solving the challenges, or problems, in the game).

What They Have to Do with COTS GBL

So when we design learning activities to extend the learning in the game, we must ensure that any additional objectives and the assessment we develop adheres to the same principles as they do within games. Just as our extension activities should be authentic and problem based, and tied to the narrative context of the game (to reflect both situated learning principles and the idea of endogenous fantasy from intrinsic motivation), so must our objectives and assessment reflect that context as well. For example, we do not want to use a multiple-choice test to assess objectives that are part of the narrative context of problem-based learning in our extension activities and/or the game. This also means the instructor must think about assessment as a continual process broken up into smaller units than the typical "test."

In addition, effective instruction builds in opportunities for application of what is being learned, accompanied by feedback, to help the learner monitor his or her own learning. We call these practice rather than assessment, since they serve a different instructional role (information processing rather than assessment). Practice in typical instruction may occur infrequently, but is a continual process in games. Practice and assessment in games often look the same and occur in close proximity to one another, being differentiated only by the presence of feedback and opportunities to reflect on that feedback.

In regards to objectives, assessment, and practice, then, the instructor must think both about how they are communicated in additional instructional activities, and how they are organized by problem and challenge, not discrete steps that must be mastered one at a time.

The NTeQ Model

These theories and instructional elements are important to the design of COTS GBL. We need to keep all of them in mind as we integrate COTS games into our classrooms. As it happens, there are models for integrating technology into the classroom, and one of them, the NTeQ model, is also well suited to COTS GBL. The NTeQ model is an established model with empirical support for its efficacy, and templates and heuristics for its implementation. Because there are many examples of NTeQ lessons available, it is mature enough to provide good support for the practical application of the ideas and theories relevant to COTS GBL. This is a model that I have worked with for the last eight years in my technology integration courses and my instructional simulations and games courses. I have seen teachers at all levels and subject areas develop dozens of lesson plans that are practical, standards driven, effective, and yet also compatible with games in the ways discussed so far (see *http://idt.und.edu/gbl*). Examples include using *American Farmer* to teach agriculture, *Contraption* to teach physics, *I Spy* to teach second grade reading and writing, and *SimCity* to teach geography and civil engineering.

This model, which takes into account the limitations and realities of the classroom, including local and national standards, objectives, access to computers, and time constraints, is founded on five philosophical premises (Morrison & Lowther, 2005):

1. The teacher is technologically competent and assumes the roles of designer, manager, and facilitator.
2. The student actively engages in the learning process, assumes the role of researcher, and becomes technologically competent.
3. The computer is used as a tool, as it is in the workplace, to enhance learning through the use of real-world data to solve problems.
4. The lesson is student centered, problem based, and authentic, and technology is an integral component.
5. The environment incorporates multiple resource-rich activities.

Premise 1. *The teacher is technologically competent and assumes the roles of designer, manager, and facilitator.*

One of the keys to successful COTS GBL is that the designer *and* the instructor be familiar ("technologically competent") both with games in general and with the game they have chosen to use in particular. In the former case, this is critical because it is not possible to design game-based learning that is rich enough in activities, content, and problem solving without understanding how games manage these things themselves. Otherwise, the activities and lesson will almost inevitably violate the principles of situated learning and endogenous fantasy, as described earlier.

It is important to know the game you have chosen very well. Because games are complex worlds that rely on exploration and variable outcomes based on the player's interactions with the game, they are likely to exceed the breadth and scope of the intended lesson. This means that while only part of the game may be used/relevant to the lesson, there may be more than one way to get to and through the relevant portions of the game. You can be sure that students will, as a class, eventually encounter all variations during game-play. Aside from potentially exposing them to undesirable content or language, this presents the possibility of exposing them to ideas and strategies that may not support the content or learning outcomes as designed in the lesson. Even when this is not the case, when learners end up in parts of the game world that are not tied to the content or lesson (and some of this is inevitable and even desired), the instructor must know how to get them re-focused and/or how to incorporate such explorations into the lesson.

The second part of this premise, that the teacher assumes the role of designer, manager, and facilitator, is also important to COTS GBL for several reasons. It requires a shift in approach from instructivist to constructivist or constructionist learning environments. The mode of game-play is player centered and interactive; instructivist modes of learning are more teacher centered. The game and classroom modes *must* be aligned for COTS GBL to work without violating the endogenous fantasy principle. This NTeQ principle is aligned with this learner-centered approach to games.

Second, whether the teacher is wearing the hat of both designer and instructor or whether those hats are worn by different people, it is critical that the distinction between the two be made. Too often, the teacher acts as designer with the knowledge that they will also be the instructor, which makes it possible to rely on their own problem-solving ability in the classroom to make design changes and modifications on-the-fly. But games are far more complex and allow for more learning autonomy than many instructors are prepared for, and because they address higher-order learning outcomes (when used properly), such adjustments are much harder to make. As a result, the design must happen in more detail up front than is sometimes assumed. So we have to be more mindful of this design process, and the NTeQ model emphasizes this.

Premise 2. *The student actively engages in the learning process, assumes the role of researcher, and becomes technologically competent.*

The key to COTS GBL in this premise lies in the assertion that the student will be actively engaged in the learning process and assumes the role of the researcher. Games, through a variety of strategies and approaches such as problem-based learning, cognitive disequilibrium, scaffolding, and question asking (Van Eck, 2006a), require active engagement; one cannot play a game passively. Educational environments typically do not support active engagement on the part of the student in this sense, however; elementary students spend more than 90% of their time in independent seat work or whole-group instruction (Pianta, Belsky, Houts, Morrison, & NICHD, 2007). The engagement inherent in games must be extended to the classroom for any instructional activities, and the NTeQ model provides the scaffolding for generating student engagement.

One of the ways it does this is by placing the student in the role of a researcher. In the NTeQ model, rather than processing information that has already been distilled down into verbal information and concepts (e.g., a textbook), the student must conduct research in order to solve problems (see Premise 4, below). This reflects the natural structure of most games as well. A goal is presented which requires the successful resolution of many challenges throughout the game. This structure then places the learner in the role of researcher; the learner must explore the environment and its challenges (gather information), devise strategies for solving the challenges (formulate hypotheses), and test and refine those hypotheses. This is the scientific method, and is at its heart what all research is. In the NTeQ model, the nature of the problem being solved determines the researcher's role and the tools he or she uses. In the case of COTS GBL, this is determined by the problems encountered within the game rather than the "real world," but is nonetheless an example of the same phenomenon. Accordingly, COTS GBL must adopt the same researcher perspective and problems from the game to the content and learning outcomes addressed outside the game, in the classroom.

Premise 3. *The computer is used as a tool, as it is in the workplace, to enhance learning through the use of real-world data to solve problems.*

The connection between this premise of the model and COTS GBL is perhaps the least obvious. The essence of this premise is that we do not use technology for technology's sake, but rather as a tool to solve problems the way we would in the real world and in different professions. Thus, an efficiency expert hired to improve productivity at a processing plant (an example of an NTeQ-type problem) might use a spreadsheet to collect data and to look for patterns and trends relevant to the problem. The teacher then would require the students, in that role, to use a spreadsheet in a similar fashion.

In the case of games, the problems and the roles and tools required to solve them help determine the roles and tools the designer then might require the learners to employ during classroom-based activities. So we have to pay attention to the roles that are or *could* be part of the game world, not the "real" world.

The second idea worth considering is that there are many roles and problems that are consistent with a game, even when they are not ostensibly part of the game. A lawyer sent over to close a deal with a toy company in Europe (the premise of the award-winning game *Syberia*) may not have to do expense reports or write legal briefs as part of the game, yet that character might very well be expected to do that in "real" life. This makes the inclusion of technology tools and tasks for problem solving feasible in COTS GBL even when they are not part of the game.

Premise 4. *The lesson is student centered, problem based, and authentic, and technology is an integral component.*

All NTeQ lessons are problem based, just as all games are problem based. Problem-based learning (PBL) is an effective and engaging instructional modality, which is perhaps one reason that games are so effective at teaching and engaging (they are themselves examples of PBL). Some might suggest that when designing activities outside the game, it is enough to simply ask the learners to look up what is right and what is wrong (that is research, right?). But doing so substitutes rote work for problem solving, which is likely to undercut engagement if not learning, and in addition ignores the richness and complexity of real research, which is always done in solution of a problem.

All NTeQ lesson problems are also authentic, meaning they center on actual problems faced by professionals in different domains that often require the integration of several strategies and tools (e.g., our efficiency expert from above would not only use a spreadsheet, but also write reports, do presentations, generate simulations, and interact with others). One need look no further than a math workbook for an example of non-authentic problems that do not engage learners ("Train A leaves Boston for Chicago going 45 mph. Train B leaves Chicago going 65 mph…"). While it may seem odd to suggest that problem solving in games is authentic, they are in the sense that they are authentic to the world (geographical, social, emotional) they are embedded in, just as problems set in the "real" world are authentic to this world.

COTS GBL requires, therefore, that activities generated to address instructional gaps in a game must also be problem based (either new problems or extensions of game problems) *and* authentic to the game world, not the "real" world. In cases where the game world shares verisimilitude with the real world, this is a simple process. But even in cases where this is not true, the skills and strategies employed in games to solve problems are quite often the same as those used in the real world, even if the problems themselves are of a fantastic nature.

World of Warcraft requires you to take on identities of creatures like elves and dwarves to go off on quests as a group. Yet while the workplace is devoid of elves and dwarves, it is full of training sessions on how to appreciate diversity, negotiate goals and solve problems as a group, and establish leadership and communication skills, all of which are what MMOGs like *World of Warcraft* require. Problems can easily be generated to address these skills while still remaining "authentic" to the game world and the problems valued therein.

Premise 5. *The environment incorporates multiple resource-rich activities.*

One of the strengths of games is that they provide a wide variety of resources and modalities within the game. This includes, of course, media such as graphics, video, animation, sound, and text. But this also includes less obvious examples such as the social context of character conversations, the distributed nature of the necessary information (players must gather resources and information from multiple sources and locations), and the overall narrative (game story) generated by the interaction of player and game. What is key to this concept in the NTeQ model, in games, and in COTS GBL is the manner in which these resources are encountered and the role that they play in solving a problem.

Both the NTeQ model and COTS GBL require the integration of many resources into the lesson, but mere presence is not sufficient. Resources must be required to solve the problem at the center of the lesson in an authentic way. It is critical to focus on the strategies and skills that are relevant to your learning outcomes rather than being sidetracked by the fantasy narrative context of the game (e.g., the *World of Warcraft* example earlier). This will ensure that you find ways to incorporate resources into the activities you

design to extend the game environment that are authentic to both the problems and context of the game you have chosen, and to the natural way in which such activities are organized by the problem at hand during game-play. Every activity should incorporate multiple resources authentic to the game and problem context, which are encountered by the learner in the same fashion as they are in the game, through the exploration, information gathering, and hypothesis testing required to solve the problem, despite their occurring outside the game (i.e., in the classroom).

Final Thoughts on COTS GBL and NTeQ

These premises are key to both the NTeQ model and COTS GBL. Keeping them in mind (and studying more about the NTeQ model) will help ensure that we adopt the right mindset for designing our own COTS GBL. Even so, experience has shown that there are a few concepts that get lost in the translation for many first-time COTS GBL designers. As we begin to shift from this theoretical discussion to a more practical discussion of how you can begin to design your own COTS GBL, here are some final thoughts on issues that many find difficult when starting out.

Integration vs. Use

There is a difference between integrating technology and using technology. Technology *use* is akin to exogenous fantasy; it is not conceptually related to the learning process or content. Using technology in the classroom means only that the teacher and/or students employ technology, most often as a tool to perform tasks related to assessment rather than problem solving (e.g., writing a research paper or book report).

Integrating technology means that technology is used to support the learning process itself, most often in terms of authentic problem solving. As such, it can be likened to endogenous fantasy; it is conceptually related (integral) to the learning process itself as a tool used in the solution of real-world problems.

COTS GBL is technology integration, not use. If you think of the game as something you will have learners do in addition to learning in your classroom, you will have lost before you begin. In everything you do, you must strive to make the content, classroom activities, and game world seamless and integrated into a meaningful whole. This is not entirely possible of course, but it should guide your design from the start.

Problem-Based Learning

The best way to ensure you are integrating rather than using the game for learning is to focus on the solution of complex problems that address your outcomes. This ensures both that you are adhering to the dominant learning modality in games, and that activities inside and out of the game are conceptually related. A good problem will suggest tasks and projects necessary for its solution, which will in turn suggest technologies that are integral to those tasks and projects.

Authentic Learning

As you design your problems, keep them authentic to both the game world and your learning outcomes. There is not always perfect alignment between the two, but compromises can almost always be found that address both. Authenticity to the game narrative should take priority whenever possible (and when it is not, you may be looking at a poor candidate game for COTS GBL).

Collaborative Learning

Regardless of how you structure other learning activities in your classroom, COTS GBL usually requires that you have learners working together.

Aside from reflecting the nature of practice in the real world and being an effective learning model in all grades and domains, collaboration places more responsibility for the learning process on the students. This ensures that you can spend more of your time facilitating learning (e.g., providing guidance, remediation, and enhancing transfer) rather than addressing technology and process problems that crop up. Students are able to solve a wide variety of such problems on their own if the learning is designed for groups rather than individuals.

Projects and Roles

What you have students do and how you have them do it while solving problems is also important. Just as we spend a large part of our time in the world solving problems, we also work on projects that are related to those problems. You should design projects that are conceptually related to both the nature of the problem being solved and the outcomes for your instruction, rather than relying solely on discrete tasks in a piecemeal fashion. Just as importantly, those projects should be authentic to the problem and the game-space, and the learners should take on the roles and characters who would ostensibly be involved in those projects in the game and real world.

PART II: PUTTING THEORY INTO PRACTICE

Theoretical frameworks and educational theory are a critical part of any endeavor to make use of new technologies to improve learning, including COTS GBL. But providing such theory without practical guidance as well is an intellectual exercise at best. Whether you use the NTeQ model to design your COTS GBL or simply rely on its premises to guide you through the process, the first part of this chapter should help ensure that you attend to the most critical aspects of COTS GBL. The balance of this chapter will outline the design process from analysis through evaluation. While not a complete step-by-step template, this process is described in enough detail to scaffold the design of COTS GBL for any topic using any (appropriate) game.

The NTeQ model itself is the subject of an entire textbook, so it is not possible to cover the development of NTeQ lesson plans and their many components while also describing the process as it relates to COTS GBL. However, the NTeQ model is quite well documented in text (Morrison & Lowther, 2005) and on the Web (*www.nteq.com*), and templates and example lesson plans for that model exist that can help you use this model in general. What follows are the areas that I have found are both critical and often overlooked or misapplied when applying the NTeQ model to game-based learning.

Know Your Audience

Many people skip this step, assuming that they know their learners well enough to make decisions about the learning process. This is rarely true, but we get away with it because students are pretty resilient when it comes to poorly adapted instruction. With COTS GBL, the temptation is to assume that all learners, by virtue of being "digital natives," are well versed in games and enjoy them all equally. Many are surprised to learn how many of their learners actually do not play games much or at all. This does not preclude the use of COTS GBL (after all, many of our students do not enjoy textbooks or reading, either), but it does have design implications.

You should begin with a formal survey of your students to find out who plays games, what kinds of games they play and enjoy, how often they play them, and why they like them to begin with. The answers to these questions will determine things like which students will need more help learning to use a game (so you can create ability-based groups), and what kinds of games to

consider and what kind of activities to design (to reflect the things they like in games, even if the game chosen may not appeal to all equally). We found that boys and girls like adventure games, strategy games, and simulations equally, for instance, but that they like different things about them (Van Eck & AIM Lab at the University of Memphis, 2006).

Know Your Environment

The place that your learning will take place is also important to analyze up front. Will your learners work during class in the classroom or in a computer lab, on their own in a computer lab or at home?[4] Obviously, there are technology issues to be solved depending upon the answers to these questions. How will you ensure that they can pick up where they left off if they will play on different computers? (Saved game files can often be transferred, but who will do this?) Do the computers available have the requisite sound and video cards, and are the networks open for collaborative game-play if needed? Knowing your environment also includes knowing the culture and whether you are likely to encounter resistance (you probably are) on the part of students, parents, colleagues, and administrators. Following a process like the NTeQ model ensures that you have documentation about the standards, objectives, and outcomes addressed, but you should also be prepared to discuss (in a non-confrontational way) the rationale for your approach.

Finding a Game

All this is, of course, before you even find a game to use, which is usually the first step people think of. Aside from looking for examples from others who have designed COTS GBL (e.g., *http://idt.und.edu/gbl or http://brainmeld.org/*), the best way I have found is to browse game titles at a local electronics store like Best Buy or online at Amazon.com. Both methods allow you to view hundreds of games in a short amount of time. Walking the aisles of a computer game section is more convenient than browsing online, since you can pick the boxes up and read the materials quickly. Browsing online provides access to more titles and information about those titles in the form of links to other relevant games, editorial reviews, and customer ratings and opinions. These latter features provide a rich resource for learning more about the game, its strategies and content, and the quality of the game itself.

Another good source of ideas for games that can be used for learning is CNN, or children, nieces, and nephews. Game players are the best source for finding out about new games and games that are popular, and they make a better resource than even online browsing since you can ask them in-depth questions about the game's specific content and strategies. You can even get them to demonstrate the games for you, which not only lets you learn more about the games, but also speeds up the process since any game player will be better and faster at game-play than any non-gamer.

So what are you looking for during this process? Obviously, titles are your first clue about whether a game might be applicable to your curriculum. Game titles like *Civilization, 1701 A.D.,* and *Zoo Tycoon* all convey enough information about their content to make them candidates for further evaluation to teach history or biology.

One of the reasons some suspect that COTS GBL has limited application to the classroom is that most game titles do not bear these kinds of obvious links to content. But the content is not always visible from the title and marketing material. While some might assume that *Zoo Tycoon* might have application for biology, zoology, and ecology from the title alone, many would be surprised to learn that some of the other primary content areas for this game are economics, business, marketing, and mathematics.[5] That is because a game's potential for teaching in different domains is not visible until one experiences the game (through research or playing it). *Zoo Tycoon* requires that

one manage the business of the park, attending to outputs from a fairly sophisticated simulation of the zoo's financial health. Factors like costs, customer satisfaction, and animal health are influenced by (and require adjustments from the player) the number of animals, cost of their appropriate habitats and food, the number of food stands, money spent on maintenance and sanitation, and the prices of admission and services. The skills required to adequately manage a zoo (or any business) far exceed the limited domains implied by the titles of such games, but this is not immediately visible to the casual browser.

Another example may help make this point here. A physics or engineering faculty who dismisses *Roller Coaster Tycoon* (*RTC*) as unrelated to physics without researching it further will be missing one of the more significant potential aspects of the game. Roller coasters, in the real world, are built by engineers who must know a lot about physics and mathematics. While the game itself does not require this knowledge, it is reasonable (and authentic!) to expect that building roller coasters in the game world would be done by engineers using these skills, and thus be subjected to the same constraints as in the real world (e.g., safety inspections, design document and blueprints, computer simulations). This opens up *RTC* to teaching physics, mathematics, and engineering as well.

And the same game can be used to teach these areas at different grade levels. Middle school and high school students might write simple reports and design documents about one part of a specific roller coaster using Newton's laws and basic computations of energy, mass, and acceleration as project outcomes, while undergraduate and graduate students could generate detailed design specifications and reports that focus on higher-level calculus, vectors, conceptual physics, and stress tolerances for an entire roller coaster, or even build simulations to test existing designs. Middle-schoolers might write reports (as zoo managers) about the financial health of the zoo or proposals(as exhibit designers) about a new animal acquisition and habitat, while graduate business majors write detailed analyses of the underlying economic model of the zoo simulation and predict its behavior if it were based on a different economic model. By focusing on the strategies required during game-play rather than just the surface content of the game, one finds that there are many games out there with the potential to teach a wide variety of topics at several grade levels.

Evaluating a Game

Once you have chosen a game for your curriculum, you have to begin the real evaluation process. A good place to start is by reading reviews and ratings of the games on sites devoted to games. There are numerous sites that do this, but rather than rely on any one site, my approach is always to use Google to find those relevant to the game being evaluated. Typing "[game name] cheat, walkthrough, guide, FAQ" as keywords usually results in several relevant hits, and you can generally find reviews one link or less removed from the pages generated.

In particular, the walkthroughs, which are documents written by game players to literally walk you through the game solution from start to finish, are invaluable. First, they let you experience nearly the full scope of the game in a matter of a couple hours. This often tells you all you need to know about whether the game has potential or not. Second, if reading them convinces you that the game has potential, they can be used to get yourself through the game very quickly. This is important because some games take experienced players 50 hours to complete. You do not have that kind of time to spend for the purpose of evaluation, yet you do have to play through the full game for reasons outlined earlier.

Before you do so, however, there are a couple of things you will need to do up front, some of which you will revisit later when preparing for

implementation. First, many games are released with bugs that require patches (software programs that repair the problems). These can be found at the game company's Web site, which is a good place to go prior to loading and playing the game yourself. In addition, many of the software programs, operating systems, and hardware drivers on your particular platform will have changed between the time the game was released and the time you install it. Once again, there may be several updates and fixes for these to install on your machine. You want to get your machine and software up to date before beginning play, both so that you do not run into problems later that cannot be fixed without reinstalling the game (and losing your progress to date) and so that you are aware of what it will take to do this on the machines your learners will be using.

Next, before you get too far into your game, you will want to test out how the saved games work and whether you can transfer them to other computers. This is because you may find during your evaluation of the game that your learners will have to play through significant portions of the game in order for them to acquire the information and context necessary for your learning outcomes. This is desirable, of course, both for maximizing engagement and learning, and for offsetting the amount of effort and planning that goes into successful COTS GBL. In some cases, however, the time required may not be justified or possible, given the constraints of the environment. In extreme cases where the learning outcomes are not a large enough part of the curriculum to justify the time spent, you should reconsider the use of this game (or perhaps any game at all). However, you may be able to "bridge" between the portions of the game that are relevant to your lesson. This can be done by saving the game at strategic points and having students play only the portions that are relevant. Many games generate separate files each time you save a game, and rely on these to track where the player was when it was last saved. Copying these files to other machines (in the same location and without changing their names) often allows you to load those games on the new machine so that your learners have access to them as well.

To find out if and how this is possible with your game, you should save a game and, if the game allows you, name the saved game (some do not) and keep track of the name. Once you have saved the game, do a search of your computer for the title you gave it. If the game does not allow named files or if you are not able to locate the file, try searching for files by time and date, and look for files created close to the time you saved the game (remember to use your computer clock in case it is not set correctly). You can also look inside the game program folder (under Program Files on Windows, or under Applications on Macintosh) and watch for any new files that show up after you save a game.

Once you find these files, you should test them to see if copying them to the same location on another computer allows that game to be loaded (in my experience, this is possible more than 50% of the time). Try doing so on one of the typical machines you think you will run the game on. Knowing whether and how this is possible not only helps you determine if the game will be useful for your lesson, but also prepares you for the implementation phase, which will require you to do the game loading and patching prior to beginning the lesson.

Design the Lesson

Because commercial games were not designed to teach content, none will be sufficient on its own as a teaching tool. As the designer, you will need to identify where there are gaps and inaccuracies in the game content, and where the strategies the game supports for solving the challenges do not align with your learning outcomes (e.g., trial and error vs. reasoned thinking) or may lead to misconceptions or an incomplete picture of the content and skills. These are the places where you

will need to design extension activities to extend the learning. Your goal here is not to provide "the answers" for these things, but to create learning activities that support the learner as they generate the knowledge necessary. As you do so, you should think in terms of designing problems, roles, and projects that are authentic to the game environment and which serve your learning outcomes as described earlier.

These activities should extend the game world in such as way as to minimize the differences between the game and classroom activities. So while it is possible to generate a problem that addresses the gaps in the learning outcomes supported by the game, doing so will not produce the desired results unless we: (1) tie the problem to the problems in the game, (2) tie the roles of the learners to the roles in the game *and* to the people who would be involved in solving such problems, and (3) tie those roles to the kind of project that such people would work on in order to solve those problems. So when designing these activities, think more in terms of problems and projects like generating legal briefs, expense reports, diaries, and feasibility studies than in terms of a research paper or workbook addressing the same content.

Likewise, you should avoid thinking in terms of one problem or one activity, instead designing periods of extended game-play interspersed by short projects over a longer period of time (days at least, and even weeks depending on the scope of your lesson). This keeps the game in the forefront and your learners engaged as much as possible. No learners are going to find these activities as engaging as the game, but their willingness to work within them will be higher to the extent that you achieve a good balance and keep those problems and activities authentic to the game.

Consider also that it is possible to use a game as an orientation activity prior to or during study of new material, as a means of practicing or assessing prior knowledge, or as a hybrid of both. In the first case, the game establishes relevance, context, and interest in the material; in the second case, the game provides practice and feedback; in the third case, the game and the activities serve as an anchoring environment that encapsulates the full learning cycle, which is ideal.

If you determine that you need to use saved games to ensure that all learners get through the game at the same pace and/or to help bridge the game-play between important sections of the game, you will also want to be cognizant of these saved games during the design process and specify where and when to load each game. Because this process of stopping game-play and loading a new game at key points in the lesson interrupts the game narrative, you should generate textual descriptions (in the form of a journal or diary of the main characters to preserve authenticity) of what occurs during the game portions students do not play. Some learners may elect to play the game outside of class rather than read these sections, and in fact this is no different than homework and reading assignments we give students all the time. But for those who are not able to complete that process, the diaries will assure that everyone has the same information needed to proceed with the game and instruction.

A final note about documentation during the lesson design process: Remember that you are designing not just the instructional materials and activities, but also all the documentation that will be needed by the learners. This means instructions for installing patches, getting help, loading saved games (and when and where to do so), FAQs, tips and tricks, shortcuts, and a whole variety of handouts that help scaffold the instructional process. Failing to do so means you will spend significant amounts of time in and out of class addressing these issues on a case-by-case basis, which is not the best role for COTS GBL or any other kind of instruction. Your role in the NTeQ model and COTS GBL is learning facilitator, not technician. These kinds of documents are not tied to the game context—they are simply help documents. But the other documents you generate as part of the instructional materials should be tied

to the game context. This can be done by doing things like generating letterhead for companies within the game world (even if these are fictional and not part of the game itself) and creating false e-mail accounts and/or printouts of e-mail messages and faxes as a means of communicating additional tasks and information about the instructional activities that extend the game. These little touches go a long way toward preserving the spirit of the game within your instruction.

Preparing for Implementation

Once you have designed your lesson (game and learner analysis, number of class sessions, objectives, standards, activities, assessments), there are several steps necessary for successful implementation as well, some of which you will have encountered during the evaluation process.

You will need to test the platforms your learners will use to see what patches and updates need to be installed, just as you did for your machine when evaluating the game—remember that something as minor as your learner systems having a different video card or version of *QuickTime* or *DirectX* can mean the difference between a game that works and one that will not start. You do not want to encounter these problems during the instruction, so you will need to check each computer to make sure it is ready to go up front. And do not assume in a lab of computers that all have the same versions of software and hardware—equipment manufacturers use "equivalent" hardware and software within single orders of equipment, resulting in different video cards, drivers, and even OS versions. Finally, if your learners will be using the game outside of the environment you have control over, you will need to provide documentation about what the minimum requirements are, how to check for them, and a disk of relevant updates and patches (if possible) for them to use. Of course, you can require them to solve these issues as well if technology literacy is one of your goals, but this can significantly impact the timeframe for your lesson, so choose carefully.

Once you have updated all of the software needed for the game to run successfully, you will want to copy over any saved game files necessary for game-play so that each installation has access to the relevant game files.

Evaluate the Lesson

This form of instruction, more than any other, requires that you collect evaluation data. This is critical both for revision of the lesson (which rarely works perfectly the first, or even second or third time), but also for documenting the benefits of the approach. Evaluation outcomes should, of course, include assessment of learning. But remember that much of the value in COTS GBL lies in addressing higher-order learning outcomes, so do not simply use measures of verbal information and concepts for assessing your content learning outcomes. Also use things like measures of problem solving, fluency in the domain, retention over time (i.e., not just immediate recall), and automaticity (speed of access to relevant knowledge). Having this data on hand is helpful not only for making the case for COTS GBL to our administrators and colleagues, but also to our students, many of whom surprisingly are suspicious that they are not learning when playing a game.

Finally, you should also include other measures: attitude toward the content area, interest in pursuing careers in the field of study, differences by different demographic categories, and ability to transfer knowledge to other situations are all good candidates for COTS GBL outcomes.

As you implement the lesson, keep a notebook handy to jot down ideas about things that worked well or did not, about unanticipated outcomes (good and bad), and about ideas for revision of the lesson later. It is tempting to think you will remember all of these things the next time, but COTS GBL is a rich, complex process, and your chances of recalling any of these things later are

very low if you do not take good notes along the way.

Once you have collected this data, do not keep it all to yourself! Share your lesson and results with your peers and supervisors, and make your lesson materials available (with copyright retention, of course) to others. You will benefit from the feedback you get from others who implement and extend your lesson, and we will all benefit from more good examples of COTS GBL when designing our own lessons.

CONCLUSION AND FUTURE TRENDS

Certainly, it *is* possible to use games without going through every aspect of the process detailed here, but results will be less than optimal. Given that COTS GBL is extremely time intensive (just the game-play and support issues, even if not for the design implied by the process I have outlined here), and given the political climate toward games in the classroom, I am not sure many of us can afford ineffective implementations of COTS GBL.

Part I of this chapter described how some theories (situated learning and cognition, intrinsic motivation) and instructional elements (objectives and assessment) are related to both commercial games and to the design of COTS GBL. It also examined how an empirically based model for developing effective technology integration lessons that incorporate authentic learning, collaboration, and problem-based learning is both effective and compatible with these theories and elements as they relate to learning in games and in COTS GBL. The future certainly holds great promise for effective, engaging games that are designed to support specific learning goals and outcomes. As design tools and theory progress (hand in hand, I hope), it will become easier to develop such games from the ground up and we will begin to see an abundance of such games. Part II extended this discussion to the practice COTS GBL using the NTeQ model, including analysis, design, development, and evaluation. The ideas in Part I were applied to each of these phases according to the unique characteristics of COTS GBL and the areas that are most commonly overlooked or misunderstood.

Progress in GBL theory and practice will proceed independently for the most part in the next few years, but will need to become more interdependent and informed by each other. Neither can truly succeed in the long term without the other.

I expect to see research in several areas, which are described in much more detail elsewhere (Van Eck, 2006a, 2007). It is all well and good to describe some of the theories and principles that operate in games (as I have done here), and this is indeed sufficient for the design of COTS GBL. But this piecemeal approach will eventually need to be replaced by integrated models of game-based learning. Models that define interactivity and engagement through game design features as well as cognitive elements such as cognitive load, cognitive disequilibrium, and the scientific method to problem solving, for example, will be key to game-based learning of all kinds.

Understanding how different game ontologies and genres (e.g., adventure, arcade, simulation, jeopardy-style frame games) support different learning outcomes (e.g., problem solving, verbal information) will require significant research. We might also expect to see a synergy between game technology such as MMOGs and persistent worlds, other instructional modalities such as pedagogical agents, intelligent tutoring systems, and authoring tools, and models of learning that focus on social networking and distributed cognition and knowledge such as connectivism.

And studies of individual differences, cognitive load, cultural differences in play and game design will all need to be conducted in order for us to truly understand the theories that underlie this new art/medium/tool. Ultimately, this may all lead to a new perspective on learning and educa-

tion that may put the emphasis back (finally) on experiential learning that is situated, authentic, and interactive as it was before the onset of the industrial revolution and the emphasis on decontextualized, mass production of learners.

In terms of practice of both COTS GBL and DGBL in general, I see several trends that are likely to continue over the next three to five years. The serious games movement is, indeed, quite serious, and there are now hundreds of good examples of serious games (games designed for purposes other than pure entertainment). These will not only become a good resource for use in our classrooms, but will also expose us all to a variety of approaches and ideas that will certainly help us design better COTS GBL as well.

It will be critical to disseminate research and practice around the design of COTS GBL. Databases of lesson plans that are vetted and revised according to their application with different populations, ages, and content areas could be very helpful in this regard, especially if they also include performance and evaluative data. Professional development around this area is and will remain important as well, with perhaps development days as well as tracks at conferences devoted to this. Infrastructure and support will be key in making this happen as well. Right now, only those innovators and early adopters will take the time to develop COTS GBL effectively—we will need support tools like authoring tools for lesson plans that scaffold the development of COTS GBL lesson plans specifically, and perhaps even instructional designers and curriculum specialists who understand these processes and can work with teachers to help develop COTS GBL. This model already exists in the form of technology partners and facilitators in the schools, and it is likely to evolve naturally as more and more technology facilitators and teachers are exposed to the theory and practice of GBL in pre-service and graduate school programs. Other issues such as lab structure, school policies, and funding streams and educational licensing assistance for games to be used in the classroom are also needed (see Van Eck, 2006b, for more on these issues).

As we build this body of DGBL (serious games, student game design, and COTS GBL), we will see more acceptance of games in the curriculum as well. This, in turn, will add to the growing recognition on the part of the game industry that education is a viable market worth exploring, and I believe developers will begin to make more concessions to learning outcomes in the design of their games. This is not to say they will begin developing educational titles (at least not right away), but I do believe that they will consider allowing educators access to games during design so that, where doing so does not require sacrificing game-play, the veracity of game content and the alignment of game and learning outcome strategies can be improved. Educators could easily co-develop lesson plans and activities that extend the game (and perhaps influence in small ways the design of the games accordingly) that could then be released with the launch of the game so educators would have a running start at using these games in the classroom.

Game developers have sophisticated tracking models for player behavior in their games so that they can evaluate their games prior to release (this is what beta versions are for, after all). The trails learners take through games (see Loh, 2006, for more on this idea) can be rich sources of data for assessment, and it would take little for game developers to make these available, even with modifications to reflect particular assessment needs.

I also see the field of serious games moving toward the development of what I call intelligent learning games (ILGs)—games that incorporate existing artificial intelligence technologies like intelligent tutoring systems (ITSs) to bring content and learning into games in a powerful and scalable way (Van Eck, 2006a). Such games will leverage the power of games and these tutoring systems (which have been found to be nearly as effective as human tutors) to help solve the

content integration problem we face in serious game development.

Similarly, both as an outgrowth of ILGs and in recognition of the need to be able to adapt other games to different learners and domains, I see the development of authoring tools as a significant likelihood for serious games and commercial games. Currently, any game-based learning works for only the learners and domain for which it was designed. If we want to extend the use of such games to other domains and learners, we must redesign the lesson or build a new game. Authoring tools—expert systems that serve as an interface between subject matter experts, and sophisticated technologies (like ITSs) so that new content can be generated by anyone with expertise in the domain—will address this problem. In this manner, we can create tools that allow teachers to generate new learning quickly and easily, as has already been done for ITSs (e.g., Susarla, Adcock, Van Eck, Moreno, & Graesser, 2003; Susarla, Adcock, Van Eck, & Moreno, 2003; Van Eck, Adcock, Susarla, & the TRG at Memphis, 2005).

While we are waiting for all these advancements, however, COTS GBL remains one of the most accessible and effective means of integrating games into the classroom, and this chapter has provided the means for you to get started with COTS GBL in your classroom.

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KEY TERMS

Commercial Off-the-Shelf (COTS): Refers to commercially available digital (computer or console) games that are designed for entertainment rather than educational purposes.

Digital Game-Based Learning (DGBL): Refers to any form of use or integration of game into a learning environment in which the game plays a central role and is itself a digital (computer or console) game. May refer to serious games, curriculum in which the students design their own game, or COTS GBL.

Edutainment: A popular term from the 1980s derived from the merging of the words "education" and "entertainment." Generally refers to computer or console software titles that are designed to teach content and which incorporate game-like features. More like tutorials than games, per se.

Game-Based Learning (GBL): Refers to any learning environments or activities in which a game plays a central role. May refer to all forms of games, but most commonly paired with the word "digital," as in digital game-based learning, first coined by Marc Prensky in 2000 in his book by the same title.

Intrinsic Motivation: As it relates specifically to games, this theory was first proposed by Thomas Malone, and later extended by Thomas Malone and Mark Lepper in 1987. In general, intrinsic motivation is motivation that stems from internal events such as goals or affective responses rather than from external events such as rewards. In regards to games, there are four factors: challenge, curiosity, control, and fantasy. In particular, the concept of endogenous (internal, tightly integrated content and narrative/game contexts) vs. exogenous (external, disconnected content and narrative/game contexts) fantasy is key to developing instructional materials to support GBL.

NTeQ Model: A technology integration model (see below) that is problem based, student centered, authentic, collaborative, and in which students take on authentic roles and use technology in authentic ways to solve real-word problems as professionals in different disciplines.

Problem-Based Learning: Learning environments and activities that place a problem at the center of the process. Learners adopt the roles of researchers and often work collaboratively to solve problems. In most cases, the problems are authentic, that is, they reflect real problems faced in the world by different professions, and require the same kinds of solution strategies. Problems serve to "anchor" learning within the problem-solving process rather than serving as assessment activities at the end of more traditional, didactic, instructivist learning.

Serious Games: Games designed for purposes other than entertainment, according to Serious Games founder Ben Sawyer (personal communication, Serious Games ListServ). Distinguished from COTS because these are not purely for entertainment, and from edutainment because the learning is much more tightly integrated with the game environments than traditional edutainment titles.

Situated Learning and Cognition: This theory arises out of a movement in cognitive studies in the 1970s that began to study human cognition in the contexts in which they naturally occur (Cohen & Siegel, 1991; Graesser & Magliano, 1991; Meacham & Emont, 1989). Research has shown that knowledge and transfer are strongly tied to context and domain (e.g., Bransford et al., 1986, 1989; Brown et al., 1989; Lave & Wenger, 1991; Perkins & Salomon, 1989) and that learning is effective to the degree that it is embedded in a meaningful context (e.g., Choi, 1995; Choi & Hannafin, 1995).

Technology Integration: The process by which technology serves to support learning, rather than as a tool for creating or dissemination materials; distinguished from technology use, which would include things like using Word to write a research paper. Generally reflects problem-based learning in collaborative, authentic learning environments.

ENDNOTES

1 Surprisingly to many, teachers are not among this group. A survey of educators in the UK found that nearly 60% of teachers were willing to consider the use of games in the classroom (NESTA FutureLab, 2006).

2 COTS games, as I will be using the term here, are generally defined as games that are commercially available and intended for purely entertainment purposes. As such, they are distinct from titles such as those described earlier from *Leapster* and *The Learning Company,* which are more typically referred to as educational software or "edutainment."

3 Many games *do* include the equivalent of pre- and post-tests in the form of a tutorial one must complete in the beginning of the game to establish the basic skills needed to interact throughout the rest of the game, and in the form of level challenges where the player must beat the "boss" (a kind of super-bad guy) before moving on in the game.

4 I am assuming that computers are the most likely platform since most schools have them, but you should consider console games as possibilities. In particular, the Nintendo DS Lite and Sony PSP are portable, relatively inexpensive, and have WiFi browsing, communication, and game-sharing capabilities.

5 In fact, these are staples of nearly every "Tycoon" game.