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CHAPTER 6

Problem-based Learning in the World of Digital Games

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Introduction

Mention computer and video games and what comes to mind? For some parents, computer and video games may be associated with addiction and violence. Most children and teenagers would associate games with fun and entertainment. Educators are likely to think of opportunities for learning. There is much debate as to the value of computer and video games in the lives of children and teenagers. Are they a waste of time or are there useful lessons that can be learned from playing such games? Regardless of one's position in this debate, the fact remains that games are a multibillion-dollar industry. Not only has Singapore hosted the World Cyber Games event in November 2005, the government will invest a total of S$1 billion over ten years to help gaming industries in Singapore (Chua, 2005a).

This chapter discusses how playing computer and video games can be a form of problem-based learning (PBL). It begins with a brief

overview of research on the effects of games on youngsters. It then reviews literature that argues and demonstrates that learning can and does take place in the world of games and that this learning shares many characteristics of PBL. The first author's personal experience with the multiplayer role-playing game *World of Warcraft*, which is played by over five million people all over the world, 60,000 in Singapore, is used as an illustration of the PBL processes involved.

What Are Games?

What are computer and video games? They are often also called cyber games, digital games, or other related names. To the nonplayer, these terms can be confusing. To be precise, computer games are those played on personal computers. Cyber games refer to those played over the Internet, in cyberspace with real online players. Video games are played on game consoles, such as Playstation and Xbox, and require a video screen such as a monitor or a television. As the boundaries between computing and video technology have blurred, it may be less confusing to use "digital games" as a general term that includes computer and video games, as well as mobile games played on cellular phones. However, Frasca (2001) defines video games as "any forms of computer-based entertainment software, either textual or image-based, using any electronic platform such as personal computers or consoles and involving one or multiple players in a physical or networked environment" (cited in Newman, 2004: 27). So, in this chapter, "video games" and "digital games" are used synonymously.

Prensky (2005) further draws a distinction between "mini" and "complex" games. Mini-games include card games, quizzes, puzzles, and board games such as *Solitaire*, *Scrabble*, and *Bejeweled*. Complex games, on the other hand, demand the learning of multiple skills which take many hours to master. In order to advance in the game, the player has to "learn a wide variety of often new and difficult skills and strategies, and to master these skills and strategies by advancing through dozens of ever-harder 'levels.' Doing this requires both outside research and collaboration with others while playing. (Is this starting to sound like something that might work in education?)"

(p. 7). Prensky explains that to go up these "levels" involves building bigger and complex cities or civilizations, conducting more challenging campaigns, battling stronger enemies, solving more complicated problems, or completing more formidable quests.

As if to confuse the nonplayer further, these games can be categorized into different game genres, some of which may overlap. Different genres might engage the player differently, and hence the learning experiences would differ. Action games often involve some kind of shooting and contain varying degrees of violence. In "first-person shooter" action games, the player has the view of the scene over the barrel of the gun. Role-playing games often involve stories with exciting and complicated plots in which the player adopts personas and takes part in quests in a fictional universe. In multiplayer online games, many players all over the world play online at the same time and interact with each other. These MMORPGs (massively multiplayer online role-playing games), such as *Everquest* and *World of Warcraft*, involve hundreds of thousands of players worldwide. Puzzle games require players to use clues to overcome obstacles and solve puzzles in a fantasy world with interesting plots and may involve the exploration of new territories or different worlds. Simulator games recreate realistic situations for players to simulate the experience that they may have of, say, piloting an airplane with authentic instruments. One popular example is *Sim City*, in which players can create and manage a city and learn urban planning skills in the process. Finally, sports games allow players to take on the role of a star athlete or favorite sportsperson. The player is often in a key position in the game, such as the pitcher in a baseball game.

A 2003 study conducted by the Parents Advisory Group for the Internet (PAGi) of Singaporean teenagers' Internet use and habits found that about 73 percent of the 12- to 17-year-olds surveyed reported playing computer and video games (Liau et al., 2005). Their favorite games were *Maple Story* and *Warcraft*, which are role-playing games, and *Counter Strike*, a first-person shooter action game. In surveys of American school children, over 90 percent reported playing digital games (see, e.g., Gentile & Walsh, 2002; Walsh et al., 2005). Perhaps surprisingly, 70 percent of children aged 8 to 16 said they played what were classified in the United States as "mature" (M-rated) video games, even though they were labeled as being appropriate for

age 17 and up (Walsh et al., 2005; for a review of issues surrounding the American media rating systems, see Gentile et al., 2005).

Research on the Multiple Effects of Video Games

Parents, educators, policymakers, and the press have expressed concern about the effects video games can have on children. Too often the question is reduced to "Are games good or bad?" In our opinion, this question misses the point. Video games have been shown to have many different types of effects—some are typically regarded as positive and some negative, some are intended and some unintended. Although there is no space here for a lengthy review, we will attempt to describe most of the empirically identified effects.

The issue that has generated the most research is that of the effects of violent video games. To date, dozens of studies have been conducted. In meta-analyses of these studies (a meta-analysis is a relatively objective statistical method for finding out whether there are consistent findings across different studies), playing violent video games has been linked with increases in aggressive thoughts, feelings, and behaviors (Anderson, 2004; Anderson & Bushman, 2001; Gentile & Anderson, 2003). Importantly, these effects have been found both in the short term (immediately after playing a violent game) and in the long term (after habitual play of violent games). In the first longitudinal study of children's exposure to violent video games, it was found that children who exposed themselves to higher levels of video game violence became more aggressive over time and that these changes were noticeable to their peers and teachers (Anderson et al., 2007). Several other studies have examined many of the reasons for these results. For example, Krahe and Möller (2004) studied grade 8 teenagers and asked about their feelings of anger, hostile intentions, and wish to retaliate. Those who played violent video games frequently showed increased acceptance of physical aggression, which they tended to see as normal. In another study, Uhlmann and Swanson (2004) observed that playing a violent game increased players' perception of themselves as being more aggressive. Funk and co-workers (2004) reported that children who frequently played violent games tended to be less empathetic toward others. They argue that children who are exposed to the violence in these games would be more likely to generalize the violence to outside the game environment. Wiegman and van Schie (1998) found that playing violent games was associated with less prosocial behavior for heavy players. Gentile and colleagues (2004) observed that playing violent digital games was associated with increased likelihood of physical fights. Although it is often argued that these associations are due to highly hostile children preferring violent games, the researchers found that the association held both for children who were high and low on trait hostility—indeed, playing such games increased the probability that children with low hostility would get into physical fights by almost ten times!

Some researchers have argued that the violence in games may have positive effects. For example, Jenkins (1999) believes that games act as a cathartic outlet for aggressive feelings. This view is echoed by Jones (2002), who also asserts that children need to kill monsters in virtual reality so that they are better able to master their anxieties and anger. However, there are several critical problems with the catharsis hypothesis, two of which we will state here (for a broader discussion, see Anderson et al., 2007). First, there is almost no scientific evidence supporting this hypothesis, whereas there is a great deal of scientific evidence for the opposite hypothesis. There have been hundreds of studies of media violence—most of which could be interpreted as studies of catharsis—which demonstrate that people become more, not less, aggressive after consuming media violence (see Anderson et al., 2003, for a thorough review). The second critical flaw with the catharsis hypothesis is that it is not how the brain works. Learning, at a neural level, is the process of making certain neural pathways work more readily than they did before. The technical term is *long-term potentiation*, which refers to a neuron that is stimulated repeatedly becoming more likely to fire because of that stimulation; that is, learning at the neural level is caused by repetition. As educators, we know that repetition facilitates learning—repeating a telephone number over and over again does not make us less likely to remember it.

Beyond an increased risk of aggression, several other potential problems have been identified empirically. For example, many studies

have documented negative correlations between video game play and school performance in children, adolescents, and college students (e.g., Anderson & Dill, 2000; Anderson et al., 2007; Creasey & Myers, 1986; Gentile et al., 2004; Harris & Williams, 1985; Lieberman et al., 1988; Roberts et al., 1999; van Schie & Wiegman, 1997; Walsh, 2000). In general, there is a preponderance of studies showing a consistent negative correlation between recreational video game play and school grades. That said, educational games have been shown to have positive effects on children's school performance (see, e.g., Murphy et al., 2001).

Parents are also worried about their game-playing children becoming addicted. Digital game addiction is not listed in the Diagnostic and Statistical Manual DSM-IV as a psychological disorder, and there is ongoing controversy as to what constitutes addiction to games, although it is clear that it must mean more than playing a lot. To be an "addict," the person must suffer serious problems in their personal lives, such as damage to schooling, career, or relationships, because of compulsive computer use or video game play (Gentile et al., forthcoming). The criteria for pathological gambling are often used as indicators of game addiction. These could include the "addicted" player experiencing a "high" when playing the game, as well as increasing hours of time spent playing being required to satisfy the player (Griffiths, 1998). The game dominates the player's life to the extent that he or she is always thinking about the game and feels physical and emotional discomfort when not playing the game. Relationships are damaged because of the player's gaming habits. The player also could experience internal conflict, such as feelings of guilt and loss of control. Although most players are unlikely to be this compulsive (prevalence rates range from about 2 percent to 15 percent; Gentile et al., forthcoming), it is not a trivial number when one recalls that over 90 percent of American children and adolescents play video games.

However, there are also several different types of studies demonstrating that playing digital games has benefits. Games have been used to help children with attention deficit disorder (Pope & Bogart, 1996). They can train and improve visual attention skills (Bavelier & Green, 2003; Greenfield et al., 1994), spatial skills (Subrahmanyan & Greenfield, 1996), spatial visualization (Dorval & Pepin, 1986), mental rotation (De Lisi & Wolford, 2002), and reaction

time (Griffith et al., 1983). Games are used by the army to train soldiers for combat (Roach, 2003). They have therapeutic applications as well, such as in pain management (Raudenbush et al., 2003) and in desensitizing phobic patients to help them overcome their fear of heights, flying, spiders, or others (Hoffman, 2004; Wiederhold & Wiederhold, 2005).

Video games can also provide opportunities for practice in the use of motor skills. In a study involving college students, playing a golf video game improved students' actual control of force when putting, even though the video game gave no proprioceptive feedback on actual putting movement or force (Fery & Ponserre, 2001). There have even been studies with laparoscopic surgeons showing that experience with video games is related to better surgical skills (see, e.g., Rosser et al., forthcoming).

We hope that this brief review makes it clear that video games can be effective teachers and that the question of whether video games are good or bad is overly simplistic. We have argued elsewhere that we should instead be considering the multiple dimensions on which games might have an effect: the amount that they are played, the content of the games, the structure of the games, and the mechanics of game play (Gentile, 2005; Gentile & Stone, 2005). Perhaps the strongest single argument we can make about digital games is that they enhance cognitive skills and can promote social and emotional learning, both for good and ill.

Do Players Learn by Playing Games?

Concern about the effects of violent games on young players stems from the fact that digital games are excellent "teachers." Gentile and Gentile (2005) listed eight reasons, which are summarized here, as to why children and teenagers are able to learn so readily from playing games:

- The objectives in the games are clear and are adapted to the prior knowledge and skills of each player.
- The activities in the games are very exciting and provide players with an "adrenaline rush."

- Digital games provide players with multiple ways of solving problems and also allow players to gain adequate experience to be able to transfer these skills to different games or settings.
- Gaming skills are organized in successive levels of difficulty with feedback, such that players acquire skills in steady stages of progress.
- Players are motivated to reach a high standard in their play and so they practice their skills voluntarily and very often to the point of mastery and automaticity.
- Players are provided with both extrinsic rewards, such as better weapons, higher levels, and more money (both virtual and real), and intrinsic rewards, in the form of higher self-esteem and a sense of achievement, so that they are continuously encouraged to take on greater challenges.
- Successful players are proud of their achievements. They gain popularity and aspire to be like the highest-achieving models.
- Every player is capable of success regardless of his or her academic performance or socioeconomic status.

The educational value of video games is elaborated in greater detail by Gee (2003), who listed a total of 36 learning principles in his book *What video games have to teach us about learning and literacy*. Gee believes that the game world provides another kind of experience that encourages active learning. Players are not only motivated to learn but also to keep on learning. One of the main reasons for this is the fact that games provide ample opportunities for players to create virtual and alternative identities. Players explore the game through the eyes of their characters and learn from the interaction of their identities with the characters in the game world and also from the identities of other players in the game. Players are not afraid to take risks in exploring the game world. If they fail or are killed, they can be "resurrected" and start all over from their last saved game. Hence, players have a sense of control, as they can customize the game to their own learning and playing styles.

According to Gee (2005), in the classroom, learners may think of creative solutions to problems, but this does not necessarily help them generate good hypotheses that they can use to solve problems which

they encounter later. However, in a game, the problems presented are well-structured and are organized such that players who generate hypotheses about solutions can test them out at the next levels:

> This well-ordered sequence creates an on-going cycle of consolidation and challenge that enables players to confront an initial set of problems, and then practice solving them until they have routinized their mastery. The game then throws out a new class of problems, requiring players to come up with new solutions. This phase of mastery is consolidated through repetition, only to be challenged again. In this way, good games stay within, but at the outer edge of, the player's competence. They feel doable, but challenging. This makes them pleasantly frustrating, putting players in what psychologists call a "flow" state (p. 2).

Games put learning in a context in which players get to use what they have learned in the virtual world of the game. Players not only learn through social interaction with other players but also from sources outside the game, through web sites and game forums where much discussion of game play takes place. Gee argues that games nurture higher-order thinking skills because players need to put the facts together to think in terms of relationships and how each step or plan they make can affect their future actions. Hence, players need to analyze their position and think of alternatives carefully, as well as to reconsider their goals and review them from time to time. Elaborating on Gee's argument, examples of how the process of playing a game can involve higher-order thinking skills are given in Table 6.1.

Research Evidence of Learning in Games

In Vandeventer's (1997) doctoral research investigating expert behavior among children who played digital games, she examined whether children with strong playing skills would demonstrate expert characteristics in other domains and what strategies would transfer to other domains by the use of such skills. She identified through her observations and interviews of 10- and 11-year-old children playing

Table 6.1 Higher-order thinking skills and skills in games

Higher-order thinking skill	Examples of cognitive skills in games
Application	• Apply information given in the game by other players or in-game characters to new situations in the game world in order to solve problems, fight battles, undertake missions, complete quests, etc. • Apply skills learned in one game to another game
Analysis	• Identify significant clues to the solutions of problems • Draw connections and classify similarities or patterns in the tasks or quests to be undertaken • Arrange or prioritize tasks for maximum efficiency
Synthesis	• Formulate hypotheses based on previous experiences and information given and predict enemies' plan of action • Integrate the different experiences of various players reported in game forums in planning the best course of action to be taken • Modify or improve on plan of action
Evaluation	• Compare information given in game forums and discriminate between useful and non-useful information • Assess actions taken in the game and explain outcome of battle, quest, or mission in the game • Recommend or decide on next plan of action to be taken

Super Mario Kart and *Super Mario World* the following learning behaviors and characteristics among the expert players (pp. 110–111):

- Actively seek new information
- Incorporate new information
- Assess situations using multiple pieces of data
- Organize, classify, and categorize information
- Consistently apply successful behaviors
- Confident about their own knowledge
- Willing to take risks
- Employ corrective action when needed
- Can consider input from multiple sources

- Recognize patterns
- Use holistic thinking
- Able to integrate information with behaviors
- Use inductive thinking
- Strategize
- Think critically
- Recognize constraints and misinformation

With regard to transfer of learning, Vandeventer found evidence of transfer for surface structure, that is, transfer of learning between elements that are conceptually similar or not too different. Similarly, Curtis and Lawson (2002), investigating whether playing adventure games could help players develop their problem-solving skills, observed only a modest evidence of transfer of general problem-solving strategies. Vandeventer argues that one should focus on the learning *process* rather than the transfer of *content*.

Squire's (2004) naturalistic study of three students playing the game *Civilization III* found that the game helped the students to gain a better conceptual understanding of history, geography, and politics and to appreciate different perspectives: "Playing *Civilization III* gave them another way into some of these same ideas—examining history and politics from other points of view, understanding relationships between geographical systems and history, and seeing how historical narratives could be tools for solving problems" (p. 401).

In a study of how games can enhance learning, Steinkuehler and Chmiel (2006) analyzed postings in the *World of Warcraft* online discussion forum that exhibited what the American Association for the Advancement of Science considers as benchmarks of scientific literacy or "scientific habits of mind." They reported that 89 percent of the postings showed that players exhibited social knowledge construction, 67 percent built on others' ideas, and 48 percent showed use of counter-arguments. Players who posted in the forum also demonstrated such cognitive skills as understanding mathematical models, understanding feedback, questioning results, and using multiple forms of argument.

Problem-based Learning in Games

Multiplayer role-playing games contain many features of PBL. The characteristics of PBL, according to Tan (2003), who has extensively studied PBL, are as follows:

- The problem starts off the learning process.
- An unstructured and authentic real-world problem is presented.
- Learning involves multiple perspectives and cross-disciplinary knowledge.
- The learner is motivated to engage in self-directed learning.
- There are opportunities for communication, cooperation, and collaboration.
- The learner develops problem-solving skills.
- There is synthesis and integration of learning.
- There is evaluation and review of the learner's experiences.

Multiplayer role-playing games typically start with the player undertaking various quests. Each quest is presented as a problem that the player has to solve or overcome. Completion of the many quests throughout the game play enables the player to advance to a higher level, where the quests become more competitive and challenging, engaging the player in more critical and creative thinking. Often, hypotheses are generated for the solution to the problem. Gee (2003) describes this process as the "probe/hypothesize/reprobe/rethink" cycle. The player begins by probing or investigating the virtual world of the game and then develops hypotheses regarding the quests to be undertaken. Throughout the game play, the player confirms or rejects these hypotheses, reprobes the game environment, and rethinks and reformulates the hypotheses, first by himself or herself, then with group members. These steps are similar to PBL processes, which Tan (2003) describes as:

- self-directed learning and self-study
- reporting to the group
- iteration of group problem solving

However, unlike the PBL processes in real life, which may take days, PBL in games may take place all within the period of a game play, such as in a battle or quest. With experience, the player learns to integrate the best plans of action and apply them to different situations in the game.

Although the problems or quests may be set in a fantasy world, they simulate real-world scenarios. Gee (2003) gives the example of the game *Deus Ex*, in which the scenario of the first quest is set on Liberty Island, New York, where a terrorist organization is holding an agent of the fictitious United Nations Anti-Terrorist Coalition hostage. In another game *Call of Duty 2*, players can experience the stories of four soldiers in combat as they reenact historical battles, facing sandstorms in the deserts of North Africa or blizzards in Russia.

The series of quests that the player undertakes in each session of game play can be considered as an unstructured "meta-problem." It becomes a real-world problem in that the player has to organize his or her priorities or goals, such as which quest to attempt first. This may involve understanding of the narrative, the game environment, characters in the game, and so on. The player has to learn the use of various mechanical input devices (such as a keyboard and mouse) to control actions within the game.

Playing in groups gives players opportunities to evaluate multiple perspectives and also to communicate, cooperate, and collaborate. The views of group members with regard to possible solutions to the problem, strategies to be used in quests, and the roles of each player must be considered and discussed.

There are also numerous game web sites and forums that offer diverse suggestions for successful completion of quests. The sheer volume of information can be very confusing. Not all the entries in these forums are written clearly and coherently. Often, writers challenge what has been posted. The attainment of increasingly higher levels in the game entails meticulous reading and sifting of available information. Self-directed and reflective learning takes place as the player evaluates and discriminates between what is useful and accurate and what is not. Game forums also provide opportunities for players to review their game experiences. When they write about their experiences and participate in the forums, they also invite criticism and feedback from other players.

Adapting Tan's (2003) model of PBL, the cycle of PBL processes in a role-playing game can be represented as shown in Figure 6.1. Figure 6.2 illustrates how games provide a learning environment for the player, which is adapted from Tan's model of how teachers design the learning environment for students.

PBL and *World of Warcraft*: A New Player's Personal Experience

This section describes the first author's personal experience of learning as a new player in the online role-playing game of *World of Warcraft*. Before I embarked on my "quest" of playing a "complex" digital game, my knowledge of such games came from reading mainly research articles and from my interviews with young players. I heard of terms like "leveling up" and joining "guilds" but could not fully appreciate what they meant. I was not able to get enough details to appreciate how leveling up can be a learning process or why joining a guild is an important part of social interaction in the game world. Reading game forums did not help very much, as the information there did not make much sense to me. Gee (2003) describes a similar experience in nonplayers:

> When I give talks on video games to teachers, I often show them a manual or strategy guide and ask them how much they understand. Very often, they are frustrated. They have no experience in which to situate the words and phrases of the texts. All they get is verbal information, which they understand at some literal level, but which does not really hang together (p. 102).

Hence, this section is written especially for nonplayers to give them a glimpse of the complex dynamics of such a game and to help them understand the learning processes involved.

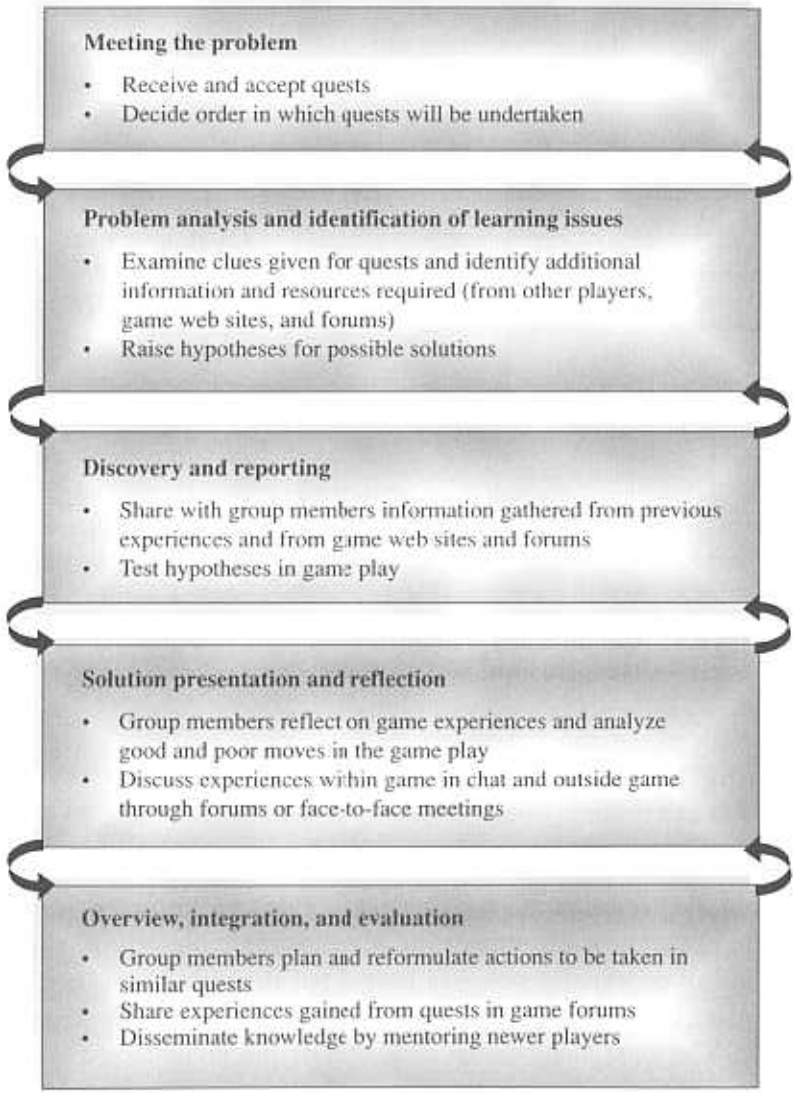

Figure 6.1 Problem-based learning processes in game play (adapted from Tan, 2003: 35)

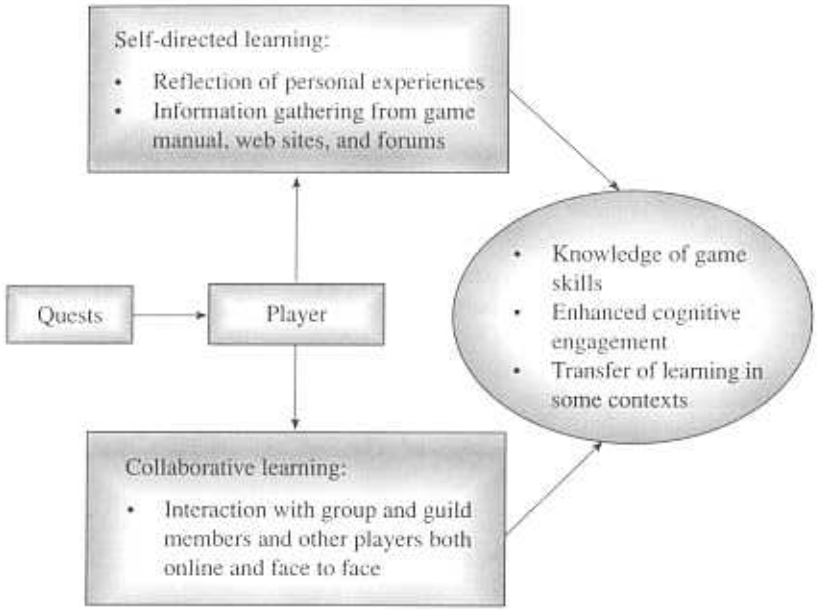

Figure 6.2 Design of the learning environment in digital games (adapted from Tan, 2003: 45)

Meeting the Problem: A Choice of Character and Identity

One of the very first problems I faced was to decide on the character I would like to assume in the game. The character chosen determines the kind of game environment the player will be interacting with and the kind of experience one will have. I felt it would be easier to play a female, gender-consistent character, and named my character Emdea. The next step was to pick one of the eight races.

Each race has its own history in the fantasy world of Azeroth. Humans, Night Elves, Gnomes, and Dwarves are members of the Alliance, whose sworn enemies are the members of the Horde, comprising the Orcs, Trolls, Taurens, and the Undead. Adding to the complexity of decision making, there are nine skill classes, namely Warrior, Mage, Priest, Rogue, Druid, Paladin, Shaman, Hunter, and Warlock, each possessing different abilities. The game allows the creation of up to ten characters, thus providing ample opportunity for

experimentation, yet further complicating decision making. consulted the game manual and the game web sites to find out mo about the races and classes, such as:

- What is the history of conflicts for each of the races?
- What are the characteristics and abilities of each race?
- What are the characteristics and abilities of each class?
- What advantages and disadvantages does each race and class have over the others?

Perhaps one of the very first obstacles a young player may face that of understanding the language. For example, the history of th Gnomes is described in the character selection screen as follows:

> Though small in stature, the gnomes of Khaz Modan have used their great intellect to secure a place in history. Indeed their subterranean kingdom, Gnomeregan, was once a marvel of steam-driven technology. Even so, due to a massive trogg invasion, the city was lost. Now its builders are vagabonds in the dwarven lands, aiding their allies as best they can.

There is opportunity for self-directed learning of the meaning unfamiliar words such as "subterranean" and "vagabond." Indee Curtis and Lawson (2002) cited several observational studies th children who play adventure games do develop their spelling, readi comprehension, and critical and creative thinking skills. Compariso of the different characteristics and abilities of each race and class, ho each differs from the other and what advantages or disadvantages th have over each other, involves analytical thinking processes.

The character that one chooses becomes very much part of on identity, albeit in virtual reality. It can be argued that your gam identity is part of your cyber-self, which is as real as you imagine to be. Turkle (1995) in her book *Life on the screen* explains that t virtual character or characters enable the player to express multip and often unexplored aspects of the self, to play with their identiti and to try out new ones. Gee (2003) argues that there are thr identities that the player has when playing a game: one's own real-l identity, the identity consistent with the game character, and t

interface between the player's real-life identity and the game character. He suggests that "players are projecting an identity unto their virtual characters, based on their own values and on what the game has taught them about what such a character should or might be and become" (p. 58). I found this to be true. Even as I wrote the adventures of my character Emdea, my identity as a player and that of my character often became conflated.

My very first experimentation with Emdea was as a Gnome Mage. As a Gnome, Emdea's first quests involved killing wild animals and delivering goods such as a mug of beer to nonplayer computer-generated characters or NPCs. I next experimented with Emdea as a Human Paladin. One of her first quests involved helping a village get rid of the NPCs known as Defias Thugs, who had taken over the vineyard. She had to kill the thugs with a mallet. Splatters of blood and guttural sounds of attack were featured in her fights. I did not feel comfortable doing this, although later I did get used to such combat. My final identity for Emdea was that of a Night Elf Druid. Like other races, Night Elves are also involved in killing, but it is for the purpose of protecting plants and animals and of research. This was something similar to my real-life interests. One of Emdea's first quests was to maintain the balance of nature:

> Greetings, Emdea. I am Conservator Ilthalaine. My purpose in Shadowglen is to ensure that the balance of nature is maintained. The spring rains were particularly heavy this year, causing some of the forest's beasts to flourish while others suffered. Unfortunately, the nightsaber and thistle boar populations grew too large. Shadowglen can only produce so much food for the beasts. Journey forth, young Druid, and thin the boar and saber populations so that nature's harmony will be preserved.

Problem Analysis

I soon found it time-consuming for Emdea to undertake one quest at a time, as she had to travel back and forth across the whole game environment to find the creatures or NPCs to report to after the completion of each quest. Not all quests are compulsory. Some planning

and organization is necessary so that quests of similar levels in difficulty and in the same location can be grouped and undertaken together.

Often, I overestimated Emdea's strength, which resulted in her being killed, although she could be resurrected when her ghost, in the form of a wisp, returned to her body. While traveling back to the scene of the fight, I used the time to reflect on how I had failed to complete the quest. Sometimes I was too impatient to take on another monster and did not wait for Emdea's health and "mana" (i.e. energy) to be restored. Sometimes, by attacking one monster, other monsters came to its aid and Emdea found herself being attacked by a whole mob. I had to strategize. I learned that the sequence of casting spells could maximize Emdea's efficiency. For example, in killing rabid bears, she could be bitten and infected with rabies, and her power would then diminish for ten minutes of game play. However, if she cast the spell of entangling roots first, the bear would become fixed to the ground and thus unable to come too close. While it was immobilized, she could then cast other spells from a distance.

To play efficiently, I needed to consider the following issues:

- What are the quests that I want to reconsider and may postpone or abandon? What is my questing program for this session of play?
- Looking at all the quests I have accepted, in what order should they be undertaken?
- What clues are given that can be used to solve the problem?
- What is the minimum level required for the successful completion of these quests?
- Do I need the help of other players and invite them to form a group?
- Do I need more information? If so, should I obtain it from game web sites, forums, or other players?

Hence, I had to draw connections, classify similarities or patterns in the quests in deciding the order in which they are to be undertaken, evaluate information given by other players or in game forums, and reflect on mistakes I had made. I also needed to raise hypotheses to find solutions to the problems or quests and to test i

the hypotheses were right. For example, in the quest "Washed ashore," the NPC Gwennyth Bly'Leggonde presented the following problem:

> Majestic sea creatures are known to launch themselves at the Darkshore coastline, beached there until they die. Lately, these beasts have been washing ashore in ever-increasing numbers. I've been sent here by the Temple of the Moon to investigate, but the presence of murlocs along the water has made my research difficult. There is a giant creature washed ashore just south of Auberdine that is ringed by the foul Greymist murlocs. Could you go there and retrieve bones from the creature for our study?

My first hypothesis was to assume that the giant sea turtle was lying on the beach. Emdea spent considerable effort combing the beach for this particular turtle. She found several other turtles lying on the beach with half of their bodies submerged in water, but these were creatures of subsequent quests and not the giant creature that Gwennyth Bly'Leggonde wanted. My second hypothesis was that this turtle would be found on the beaches of one of the offshore islands. Again, Emdea's search along the shores of these islands proved futile. The third hypothesis, which proved to be correct, was that the creature must be submerged. Emdea was then able to retrieve its remains by diving underwater.

Discovery, Reporting, and Solution Presentation

I befriended an experienced player from Malaysia whose character was a Night Elf Priest named Angelpea. She introduced Emdea to her "tank," a Human Warrior named Emil. I learned that a tank is a character who can absorb or withstand more damage from attacks in a fight and thus can afford protection to weaker characters. Tanks often pull (i.e., lure) monsters toward a waiting ambush group. With Angelpea's help, I joined a guild. Through the chats of guild members discussing their recent adventures, I gained some insights into their raids and battle strategies.

Emdea's effort to complete the quest known as "Uncovering the past" is an example of collaborative and cooperative play, which I undertook with two other players. The quest was given by an NPC named Prospector Whelgar:

> Just before the invasion I uncovered a large table called the Goaz Stone. The translated text breaks off in 4 places. The text speaks of a "divine plan" and a "doomed prophecy." I fear we are running out of time. I am too old to go down and brave those beasts. But you are strong. Scour the excavation site and uncover the 4 missing table fragments: Ados, Modr, Golm and Neru. Search for them in ancient artifacts or where the soil is loose. Bring them to me so I can begin unlocking the mystery!

The three of us formed a group and helped each other with idea on where and how to find the fragments while battling the creature that attacked us. Aldeus's Human Warrior character could take a lo of damage, so he often acted as the tank. Thorgor's Dwarf Paladin wa also a tank and had the important role of resurrecting Emdea an Aldeus when they were killed in fights. Emdea's role was to empowe the group with spells to strengthen, heal, and rejuvenate. Durin fights, she could also help entrap the enemy with entangling roots t prevent it from advancing so that her partners could continue thei attack. Some of the fragments were not easy to find, but wit suggestions from members of the group the three of us managed t complete the quest rather quickly.

Reflection

As Emdea traveled from one place to another, the journey provide me the opportunity to reflect on mistakes made. In a quest to fin members of an excavation team, Emdea was killed several times b creatures called raptors, although she was only one level below their While traveling to find Emdea's corpse, I asked myself these question

- Why was Emdea not powerful enough to kill the creature which are just one level above her?
- What measures can I take to prevent Emdea from being kille again?
- Would Emdea be more successful fighting with a group?
- Is Emdea's failure due to her inexperience in fighting or he misunderstanding of the quest?

I realized that one of the weaknesses of the Druid class is the high consumption of mana in casting spells. Emdea often ran out of mana, which made her vulnerable as she would then be unable to cast a spell on the enemy to defend herself. Perhaps I should have transformed her into her bear form, which possesses more health and armor and is better able to withstand attacks or damage. Or perhaps I should have transformed her into her cat form and used the "prowl" feature, which would allow her to move unseen among the raptors while recharging her mana and looking for the missing excavation team at the same time. Another possibility was that Emdea may have been fighting in a location where the creatures were part of another higher-level quest.

Social and Emotional Learning

Although much of the programmed content of the game can be described as violent, as it involves fights with monsters, battles, and raids, I encountered many instances of prosocial and altruistic behavior during the game. Often, characters who passed each other along the road bestowed "buffs" on each other without having to ask for them. Buffs are spells that strengthen the characters. Higher-level characters rushed to the assistance of lower-level ones, and those with resurrection spells often revived the killed characters without having to be part of the group. Players could understand each other's difficulties and frustrations. Much later, when Emdea attained a level high enough to have an animal to ride on but could not afford one, Rohirm, who empathized with her problem, bought her a striped saber-tooth tiger mount and Shizune gave her new clothes.

Social encounters in the game can be opportunities for social and emotional learning. On one occasion, Emdea and another Night Elf player named Mavis were celebrating the successful completion of their quests by dancing on the beach in their swim wear when they were joined by two male Night Elves. The situation had become a beach party. Mavis continued dancing and gyrated happily with one of the male Night Elves, and Emdea was expected to do the same. The other male laughed and said, "My dream comes true—two women!" I was unsure about the role that Emdea should play, but I was uncomfortable with the sexual innuendo in his remark. Despite

social pressures to stay, Emdea assertively but politely extricat herself from this situation.

On another occasion, Emdea was accosted by two higher-lev Undead characters. The Undead and Night Elves belong to opposi factions and are therefore traditional enemies in the game. They ma rude gestures at her and taunted her to fight. Although it was tempti to accept the challenge, I decided that it would be more prudent f Emdea to ignore them and leave the scene. I interpreted the intentions as being playful rather than malicious. This incident inspir me to play the game as an Undead character on another occasion.

It should be noted that there are multiple game servers on whi these games are played. I typically only play on the "player vers computer" servers, but there are equally popular "player versus playe servers, on which players typically do fight each other. Thus, although are all playing the "same" game, the experiences of two players could radically different: mine have been primarily collaborative and prosoci whereas another player may have primarily aggressive experiences.

Multiple Perspectives

As World of Warcraft allows players to participate as more than o character, I decided to create Einut, a male Undead Warlock charact to play the game from a different perspective.

On reading the history of the Undead, I learned about the enm between Night Elves and the Undead. While Night Elves a protective of nature and ally themselves with other races in t Alliance against those who destroy the environment, the Undea main concern is their own survival. They have broken free from t tyrannical rule of their former master but are rejected by others a are known as the "Forsaken." They thus oppose all who are a thre to them, including the Night Elves, and have no qualms abo developing devastating plagues as weapons.

Evaluation

Emdea's successful collaboration in the quest "Uncovering the pas was the result of learning from a failed attempt of a previous que This was a quest to gather the brain stems of creatures called nag

and satyrs for research purposes. It entailed fighting the creatures in a dungeon, which was difficult to do without group effort. The group comprised members who happened to be at the site. In other words, it was a "convenience" group. Members attacked the monsters without a plan, and there was a lack of communication with regard to the roles of the group members. We assumed each member knew one another's roles. Emdea was constantly low on mana. Later, I realized that Emdea should not have attacked first but should have allowed the Warriors in the group to do so, as they can withstand damage better than Druids. Emdea should have used her healing and rejuvenation abilities to empower the group instead of duplicating others' efforts. Had I understood this earlier and analyzed the abilities and skills of each of the group members, I could have contributed to the group's efforts more efficiently.

After completing some of the more challenging quests, I checked out the posts in the game forums and compared my experiences with those of other players. Often, I learned "shortcuts" that I could have used to carry out some of the quests more quickly and efficiently.

Content versus Process

If learning is perceived in terms of *content*, and I am asked *what* I have learned, then my answer would be that I have not learned very much. Emdea went on missions to preserve nature and help recover archeological relics, but I, the player, did not gain much knowledge about either natural sciences or archeology. However, if I were to consider learning *processes* rather than content, and *how* I have learned, then I can say that playing the game has engaged me cognitively. Each game-playing session presented different quests with different players of various roles and abilities. Each session was a PBL scenario, demanding resolution of problems which involved PBL processes. Through my game character's pursuit of quests and interaction with other real players, I had to plan my actions in the game, predict outcomes, anticipate results, and analyze my mistakes. I collaborated with group members, evaluated suggestions and comments posted in game forums by other players, and became more aware of how I

responded in different social situations in the game world. Gee argues that video games require and reinforce players' commitment of "time, effort, and active engagement" in such a way that they can experiment with identities and eventually "see themselves as the *kind of person* who can learn, use, and value" what is being learned (2003: 59). Wouldn't we wish, he continues, to have our students try on a scientist identity in our science classes? Vandeventer (1997) takes this argument even further, stating:

> The key lies in considering not the *content* of the videogames but the *process*. Through the process, students are developing critical abilities important to education. It remains to educators to define ways to use these previously untapped cognitive resources. It is these processes which hold the most promise for helping educators define new ways to help achieve connections to transfer (p. 115).

There are, of course, players who play the game mindlessly and are unaware of their thinking or learning processes. Perhaps those who benefit most would be in the categories of what Bartle (1990) describes as achievers, explorers, and socializers, rather than killers. However, note that even those players whose main goal in games is killing NPCs or other players are learning how to do it better over time and are engaging in PBL (just that it involves problems that the military appreciates more than most teachers). More research is needed to find out what kinds of players would derive most cognitive benefits from playing games. How educators can utilize game features and make use of PBL processes in game play is another area to be explored.

Virtual versus Real

One argument that we sometimes hear is that a game cannot have any important effects because players know it is "just a game." However, there are two problems with this argument. First, it is unclear if it matters—every adult knows that advertisements are "fake," yet they still work. Knowing that the media content is not real does not seem to preclude its having observable effects. Second, the line between

virtual and real is blurring over time. Real money is sometimes paid for virtual goods (Swee, 2005; Chua, 2006). In the *World of Warcraft*, it is possible to purchase, through the Internet, virtual money with real money. In fact, there is currently an exchange rate of 2,000 *World of Warcraft* gold coins for US$100 (Tschang, 2006; Barboza, 2006). Indiana University associate professor of telecommunications Edward Castronova describes the buying and selling of virtual goods that takes place in auction houses in the *World of Warcraft* cities as resembling that at the New York Stock Exchange. He terms virtual reality as a "synthetic world," and in reply to the charge that virtual reality is not real he argues, "When it becomes millions and millions of working adults getting involved in alternate reality spaces with as much political, economic, and social richness as the real world, the argument loses its power" (Indiana University, 2006). Castronova echoes what Yee (2006) found in his research on 30,000 online gamers. In his conclusion, Yee surmises that

> MMORPGs are "places where alternate identities are conceived and explored. They are parallel worlds where cultures, economies, and societies are being created. They are environments where the relationships that form and the derived experiences can rival those of the physical world. They are platforms for social science research. They are places where people fall in love, get married, elect governors, attend poetry readings, start pharmaceutical business, and even commit genocide. Whatever MMORPGs are, or will become, one thing is clear. They are not just games" (p. 38).

It can be argued that my learning experiences in playing *World of Warcraft* are merely virtual. However, I found that virtual experiences can be quite real. My social interactions in the virtual game world were with real people, and pleasant encounters strengthened ties of friendship. After many weeks of questing with Holymn from Colorado, Overcat from Indiana, and Silverarrow from Arkansas, Emdea from Singapore developed strong bonds with them (Figure 6.3). After all, we had battled numerous monsters, accomplished hundreds of quests, and even died and were resurrected together. Throughout the course of the game, our characters of Dwarves and Night Elves also shared personal information about our

Figure 6.3 Emdea and Overcat fishing off the coast of Feathermoon Stronghold in Feralas (permission for use courtesy of iGame Asia, the exclusive distributor of *World of Warcraft*)

real lives, jobs, interests, and families. In three separate lectures where I demonstrated *World of Warcraft* to parents and teachers who wanted to know more about the Internet and digital gaming, my online friends "appeared" as guest speakers in their characters. Holymn demonstrated how characters could converse and show emotions through the "chat" and "emote" functions in the game. Silverarrow, who plays with his teenage son, cautioned against getting "addicted" to the game; and Overcat, whose real-life profession involves law enforcement, advised parents to monitor their children's Internet chat sessions closely. After I stopped playing the game as Emdea, I felt a real sense of loss and more than a tinge of sadness having to leave my online friends, whom I had grown to be quite fond of. I gained a better understanding of how one can be "addicted" to online social relationships and one's character in the game. I have since resumed the game and continued these relationships, as well as cultivated new ones.

What we know about neural network development suggests that we need to pay much closer attention to video games. One major way humans learn is by repetition. In short, the brain is what the

brain does, so whatever is practiced becomes learned. This is why we give students homework. Therefore, if players play more than once, we should be attending to the multiple dimensions on which video games might have effects, which are summarized below (for more detailed discussions of these dimensions, see Gentile, 2005, and Gentile & Stone, 2005).

First, the *amount* of game play can have significant effects on learning, both positively and negatively. For example, many studies document a negative relation between total amount of play and school performance. However, video games encourage optimal "study" habits. The initial playing sessions are often lengthy, as the player begins to learn the basic skills. This combination of massed practice to build sufficient initial mastery to play the game followed by distributed practice over days or weeks to prevent forgetting is optimal for the development of automatized structures of knowledge, or schemas (see, e.g., Ellis & Hunt, 1993; Anderson, 1983; Glaser, 1984).

Second, the *content* of the games (whether educational, prosocial, or violent) can lead to "learning," both explicitly (e.g., learning history from *Civilization III*) and implicitly (e.g., learning aggressive cognitive scripts and attitudes from *Grand Theft Auto*).

The third dimension is the *structure*. This chapter has concerned itself primarily with the structure of video games. We have previously defined this as "form," meaning the formal features of the game that can change learning (e.g., improve attention skills or the ability to transform two-dimensional images to three-dimensional representation). However, here we extend that definition to include how the learning environment is structured to facilitate exploration and problem-based learning (or not). Thus, if players practice the skills of analysis, synthesis, evaluation, and application (as we argue here that they can and do), they should become better at those skills.

Fourth, the *mechanics* of game play can transfer to other skills and also facilitate the transfer of content and structure. For example, keyboarding skills, mousing skills, and hand-eye coordination do improve with the use of computer input devices. These skills also are likely to transfer to other nongame applications. Furthermore, learning and transfer should improve to the extent that mechanical input devices are similar to other real-world devices. For example, playing driving simulation games with a steering wheel and pedals should transfer to real-world driving to a greater extent than playing the same games with a mouse and keyboard (although this hypothesis has yet to be tested).

Ultimately, we argue that the question is not whether video games are good or bad, but it should be what educators and parents can do to help children minimize or ameliorate any negative effects while maximizing learning experiences and cognitive benefits. This becomes a pertinent question for educators, especially in the light of plans to start infocommunication clubs in 150 schools in Singapore by 2008 to encourage game development (Chua, 2005b). Perhaps it is important to provide a balance of challenging real-world quests that interact with those of the world of games. For us, writing this chapter is the first step on that quest, and we hope that it provides some clues for others to complete it successfully.

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