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Designing for Learning: Multiplayer Digital Game Learning Environments

Author
Kim, Chung

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Designing for Learning:

Multiplayer Digital Game Learning Environments

by

Chung On Kim

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Committee in charge:

Professor Yehuda E. Kalay, Chair
Professor Galen Cranz
Professor Kimiko Ryokai

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Abstract

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Many people in general think that digital game environment has potential as a learning environment. However, empirical research in digital game environment and education is a still relative young field, so to create a digital learning environment where students are actively engaged in the learning process is a great challenge. In part, it has been challenged by differences between the games domain and context of learning, and also the lack of understanding of the many different professionals who are involved in the process of making it.

Over the past three years (2005-2008), the Digital Design Research Group at University of California, Berkeley, has had an opportunity to design a Multi-User Online Game environment representing Seventh Street, West Oakland, where players can experience and learn about an important historical and cultural place that was destroyed by various urban renewals about half a century ago. Is "being" in the authentic environment enough for learners to gain the knowledge they need? How do we balance design tensions between meeting learning objectives and creating an engaging learning environment?

This dissertation looks at various learning theories that build a framework for learning environments. It then explores the idea of using the new media, the digital game environment, as a new learning environment. Following these discussions, the West Oakland game environment is analyzed as a learning environment. The outcome of this analysis emphasizes the importance of content development in Multiplayer Digital Game Learning Environment.

Guidelines for designers of Multiplayer Digital Game Learning Environment are discussed. This study has broad, practical implications for designers who seek to both educate and engage learners, and who like to recognize why we, as architectural designers, need to be involved in creating learning environments beyond physical environments.

Dedication

I would like to dedicate this Doctoral Dissertation to my late father, Sung-hyun Kim. There is no doubt in my mind that without his continued support and encouragement, I could not have completed this process.

Acknowledgement

I would never have been able to finish my dissertation without the guidance of my committee members, help from friends, and support from my family.

I would like to express my deepest gratitude to my advisor, Dr. Yehuda Kalay, for his excellent guidance, caring, patience and encouraging me to join Digital Design group. Without Professor Yehuda Kalay's help and encouragement, I think I would never have written my dissertation. Thank you, Yehuda!

My special thanks go to Dr. Peter Lyman, who is no longer with us, for taking me and advising me through his illness, and also supported me to join his research group, Digital Youth Project.

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I thank my friends, William Willoughby, Joseph Strelka, Henry Stepp, and Selina Lam for their great friendships and supports for all these years.

Lastly, I dedicate this dissertation to my parents and my sister; this dissertation is simply impossible without them. I am indebted to my father, Sung-hyun Kim, for his care and love. Although he is no longer with us, he is forever remembered. I am sure he shares our joy and happiness in the heaven. I thank both our biological mother, Kyu-Nam Kim, and our stepmother, Kyung-Hee Rye. Although, our biological mother passed away more than 20 years ago, her dedication and discipline always has been a constant reminder for me. Also, without our stepmother's support and care for many years, it would not be possible where I am right now. Finally, thanks to my sister, Bosoon, for her patience and support in my many years of graduate study.

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Chapter 1 Introduction

1.1 Motivation

In a traditional classroom setting, the teacher controls the environment of the classroom. A student is expected to remain seated in a specified location and straight rows tell him to look ahead and ignore everyone except the teacher who, with her back to the students, writes important messages on the blackboard. The learning process is designed for information to be transmitted from the instructor to the student. The teacher controls what the students learn and at what pace they learn. These conventional strategies create a passive learning environment because the setting does not foster student interaction. An environment such as this does not encourage students to process information actively. For the most part, the content presented in the classroom is disconnected from its real-world context. Information conveyed in the classroom tends to be situated in the context of the classroom and the school rather than in the context in which the information was created (Henning, 1998). At the same time, real-world learning situated in real-world contexts has been shown to have positive impacts on learning and learner motivation (Duffy & Cunningham, 1996).

We understand that learning is not simply a passive response to the teacher's *delivery*. Rather, learning is an active, constructive, cognitive, and social process by which the learner strategically manages available cognitive, physical, and social resources to create new knowledge by interacting with information in the environment and integrating it with information stored in memory (Shull, 1998). From this perspective, knowledge and learning are the result of reciprocal interaction between the learner's cognitive resources and aspects of the external environment.

Here the idea of "environment" is not merely the physical description of space but it is a set of external conditions, including both physical and interpersonal surroundings that can influence the learner. The Environment, or *place*[1], is the interrelationship of context, activity, and people that defines the social and cultural setting which positions the learner in the center of an instructional process, consisting of content (the facts and processes of the tasks), context (the situations, values, beliefs, and environmental cues by which the learner gains and masters content), community (the group with which the learner will create and negotiate meaning of the situation), and participation (the process by which the learner, working together and with experts in social organization, solves problems related to the subject being learned) (Brown, Collins, & Duguid, 1989; Lave, 1988).

For John Dewey (1859-1952), experience was a key, for he believed that constant interaction of human with his environment, the world of experience, was essential for growth, thought, social progress, and personal development. In *Experience and Education* (1938), Dewey maps out what he means by an "experience," and what it takes for an experience to carry "educational' value. One of Dewey's premises is that learner experience results from the interaction between the learner and the environment: "Factors that affect learner experience include those that are 'internal' to the learner, and those that are 'objective' parts of the environment. The learners'

[1] Canter (1997) has developed a 'facet theory' of place which includes activities (one of the facets), physical characteristics, the individual, social and cultural experience and the scale of the place.

perceptions of, and reactions to, the objective factors are influenced by their attitudes, beliefs, habits, prior knowledge, and emotions." He also stated that, "every experience both takes up something from those which have gone before and modifies in some way the quality of those which come after" (p.27). Dewey explained that people develop habits of emotional response, perception, appreciation, sensitivity, and attitude. These habits, developed from past experiences, affect future experiences. The question for designers therefore becomes, how can we design experiences that allow learners to experiment with knowledge in context, encouraging them to form connections by experiencing a wide range of experiential possibilities around any given piece of information?

1.2 A New Learning Environment

A game is a form of play that is artificially constructed, competitive, and voluntary activity or occupation that resembles portions of reality and involves one or more players who assume roles while trying to achieve a goal within a specific context. It provides a competitive environment for a player by challenging him or her to reach a goal. Rules, freely accepted but absolutely binding, determine what the players are permitted to do, or define constraints on allowable actions, which impact on the available resources, and therefore influence the state of the game space.

Recent uses of technology have moved the world of games beyond the deck of cards or board games of generations gone by. In recent years, the popularity of the digital game[2] has prompted digital games to become a source of study for researchers and designers investigating how various aspects of game might be appropriated for learning. As opposed to traditional classroom environments, where the learning model is one of transmitting content, digital game-based pedagogies hold a situated, interactionist view of learning where players enter with understandings, identities, and questions, and through interaction with the game system, develop along trajectories toward more expert performance. Thus, educational games are systems of potential interaction (more or less) carefully orchestrated to guide user's experience (and learning), with academic knowledge, skills, values, and identities developing as a result.

According to Winn (2002), the current movement within the field is toward the cultivation and development of interactive learning environments, especially interested in Multiplayer Online Game (MOG). MOG is a computer generated 2-D or 3-D videogame played online, allowing users, through their digital characters or "avatars," to interact not only with the system (the designed environment and the computer-controlled characters within it), but also with *other users'* avatars. Given the complexity of digital games such as *World of Warcraft* and the ability of gaming technologies to support interaction among thousands of users in photorealistic worlds and in real time, it is no wonder that digital games are attracting attention as a medium for learning (Aldrich, 2005). This kind of digital environment creates a kind of persistent social and

[2] For the purpose of this dissertation, I am using digital games as a broad term to reference any game that is played on an electronic device such as a computer or television. Other games on cell phones or other personal pieces of electronic equipment, such as handheld units, will be noted if it requires specific explanations in relation to the content.

cultural world, loosely structured by narratives[3], where users are largely free to do as they please within the limits of the system or world. It is a persistent, networked, interactive, narrative environment in which players collaborate, strategize, plan, and interact with objects, resources, and other players within a multi-model environment. Additionally, collaboration and critical thinking are activities central to the MOG gameplay experience.

The MOGs could provide a set of experiences, with the assumption being that learners are active constructors of meaning with their own drives, goals, and motivations. Also, MOGs could provide learners with situated experience of activities, whereby they develop new ways of thinking, knowing, and being in worlds (Shaffer, Squire, Halverson, & Gee, 2005). (Situated Learning is going to be further explained in Chapter 2)

MOGs are ubiquitous to contemporary pop culture, yet there is still a relatively paucity of research on the phenomenon as far as learning is concerned. Despite frequent public dismissals and indictments, MOGs do constitute a complex and nuanced set of multimodal social and communication practices, tied to particular communities and consequentially for membership and identity (Gee, 2003). Understanding the form of (voluntary) participation in complex environments such as MOGs, where learning is the precursor to playing, is crucial. Virtual communities function as a major mechanism of enculturation for those engaged with them: "Playing one's character(s) and living in [these digital environments] become an important part of daily life. Since much of the excitement of the game depends on having personal relationships and being part of [the] community's developing politics and projects, it is hard to participate just a little" (Turkle, 1995, p.184).

If we take McLuhan's 'the medium is the message' seriously, then it is interesting to think about how representing ideas through digital game environments, such as MOGs, remediate how we experience those phenomena (Holland, Jenkins, & Squire, 2003). Conceptualizing domains through the medium of game environments means rethinking content in terms of designed experience, as represented through challenges, goals, and practices. Such an approach might allow educators to go beyond traditional notions of education as "exposure to content" and re-imagine it, along progressive lines, as enrichment of experience (Dewey, 1938; Gee, 2004).

1.3 Similar but not the same

Even though MOGs become more mainstream and the idea of games as a learning medium gains acceptance, the promise of MOGs being learning tools remains largely unrealized. Although the edutainment[4] industry (initial attempts at learning media) has gown in sales over the years, it has not revolutionized learning nor experienced the explosive growth originally predicted. Why?

We cannot fully adopt the MOG model as it is. The first issue is the difference between the games domain and context of learning that dominates education and the gaming industry: they

[3] In digital games, a narrative is an account of something that happens to someone (Barrett, 1997). It consists of series of events, from the background setting to the completion of the game. Discussed in more detail in chapter 5.

[4] Edutainment is "… the marriage of education and entertainment in a work or presentation such as a television program or a Website." (Jones et. al., 1999).

are too different to allow for good synergies. In the world of education, the focus is on providing the best path for learners to get from novice to expert in different domains. The game world, in contrast, is focused on providing a rewarding, interactive experience. Content is secondary to experience and is willingly sacrificed for gameplay[5] when and where needed. In the case of edutainment titles, these worlds often clash, with educators developing content (often linear, hierarchical, and instructor-centered) without regard to strategy and experience, and game developers building interactive environments (often player-driven) without regard to the content or instruction. The goal of an educational game environment has to engage the learner in meaningful activities that not only fulfill the psychological needs provided by gaming experiences, but also support cognitive processes and instructional content in ways that make the learning relevant and authentic in the game context.

Another issue is that the use of graphical representations of participants and environments does not always help interpersonal or social interaction. The lack of intuitive and non-intrusive non-verbal cues is one of the distinctive features that separate computer-mediated communication settings from face-to-face encounters. Even multi-user games, although social by nature, have fundamental problems in supporting interpersonal activities, and thus, players constantly seek workarounds in order to fulfill their need to communicate and socialize. In virtual learning environment, it is vital to establish a personal connection to others and to the instructor. Also, it is important for students to have engaged and collaborative learning experiences (The importance of how narrative and gameplay help to form the rich learning experience will be discussed in later chapters.)

There are great potentials that, combined with other emerging technologies like desktop computer games and maturing technologies like web-based learning that will allow instructional designers and educators to have an unprecedented opportunity to create blended learning environments that are highly interactive, meaningful, learner-centered, and that can deliver meaningful content. But how do we balance design tensions between meeting learning objectives and creating engaging and fun learning environment?

Up till now the use digital games for facilitating learning has been in its infancy stage and is a scattered filed without internal consistency and successful application (also see Squire, 2002). There has been some progress made through initiatives like the Serious Games[6] initiative, but blending instructional content and games remains a significant challenge. Part of the reason for this is that the field of edutainment is too young to have many established research methods and theoretical models for digital game design, let alone instructional games (Prensky, 2001; Pearce, 2004).

This brings up a last issue, namely, a lack of experience in developing digital game environment itself that is educational. One of the reasons is that game designers do talk about their craft, but the craft is only recently started to be studied academically and game design details are still

[5] Gameplay is the experience of a formal system, constituted by rules that constraint player agency towards interesting challenges, with intention of achieving specific goals. Discussed in more detail in chapter 5.

[6] A serious game is a computer-based game with the goal or education and/or training in any form. This stands in contrast to traditional computer games, whose main purpose is to entertain.

largely viewed as proprietary concerns as that such details tend not to be widely published. Crawford (2003) observed that game design has not really kept pace with game technology. Although computer hardware has evolved dramatically in terms of speed, processing power, and capacity, the games being designed now do not necessarily offer better gameplay than those designed when he wrote his first book, *The Art of Computer Game Design* (1982). He also notes that there is more to game content design than game programming.

There are many efforts and attempts to understand how this new learning media can potentially affect the way we learn by analyzing mostly commercial digital games that are currently available. Marc Prensky (2001) claims that, "if you know something well (in theory), you can become a digital game-based learning creator." However, the development of motivating and inspiring digital learning games is a complex multifaceted task. (Figure 1.1) At its best, the quality development of digital learning games is a multi-disciplinary and user-driven process, which thoroughly combines the expertise of fields such as instructional designer, software engineering, user-centered design, game design and development, and the content disciplines of specific games. Although the field has become more sophisticated in terms of idealizing how to make effective educational games, offering theoretical frameworks (Squire, 2006; Steinkuehler, 2006), design principles (Squire & Jan, 2007) to bring about academic ends, it still needs the great understanding of how these theoretical frameworks and design principles actually can be implemented in digital game environment effectively: as designers, we must understand both the theoretical aspects and the practical necessities of design.

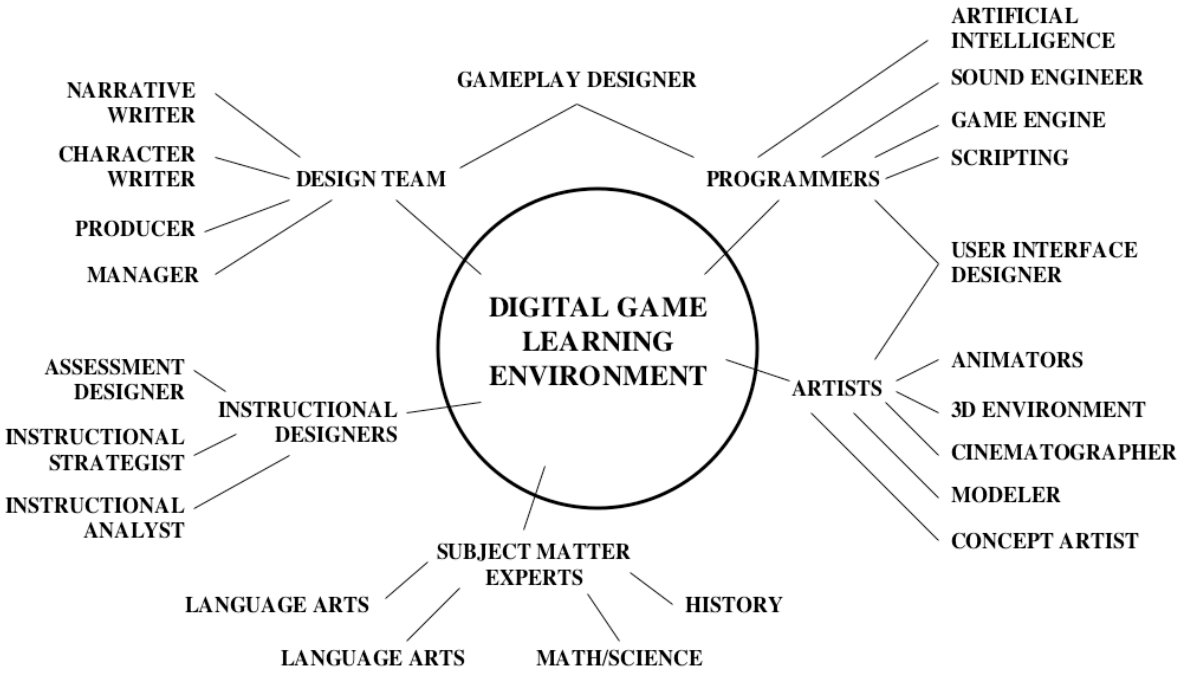

Figure 1.1 Digital Game Learning Environment Development Team

1.4 Research Problems and Method

This dissertation is to attempt the beginning of the answers lies in the framing of the problem for designing multiplayer digital game learning environments. The dissertation's goal is to frame the design guidelines for developing multiplayer digital game learning environments that account for the strength of both the education and game worlds. How could the multiplayer digital game learning environment be arranged in a pedagogically good way?

Digital Game Learning Environment is a product of many different components from various design fields, as shown in Figure 1.2.

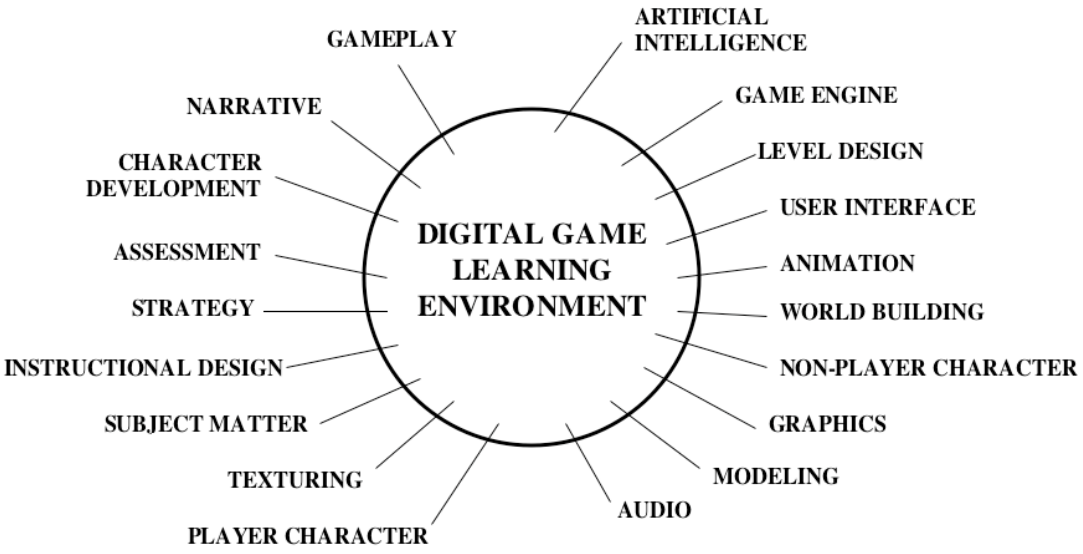

Figure 1.2 Components of Digital Game Learning Environment

Digital game design requires knowledge in game development, as well as human behaviors and the concept of *play*. However, digital games have been driven by technical advancement over the years, and are often being evaluated and described based heavily on their technical aspects such visual graphics and game mechanics, while ignoring the importance of game content (Falstein, 2002). Understanding of the complexity of game content structure is important and also how this will shape the learning experience in digital game learning environments:

- Play activities linked to learning;
- Narratives and gameplay that drive these activities; and
- Dynamic, intelligent NPCs who offer information about content presented in the three-dimensional space, directions regarding play and learning activities, and opportunities for remediation related content.

This dissertation analysis presents: (a) an overview of design elements to take into consideration when designing a multiplayer digital game learning environment, (b) discussion of how

narrative, gameplay, and non-player character (NPC)[7] aid as the major content elements in MOGs, (c) a discussion of how the narrative structure can foster learning, (d) a discussion of how the gameplay can creates engaging experiences in learning, (e) a discussion of the important role of non-player character in new learning environments.

For the study, Virtual West Oakland (VWO) project is used as a case study. VWO is a virtual "world" that intended to introduce school-age children to the lost African American cultural heritage of Jazz and Blues music that flourished on Seventh Street in Oakland, California in the 1940s and 1950s that has been lost to urban renewal. The project serves to test the ability of this new medium, not only to communicate cultural heritage, but also to foster as a new learning environment. The format of this project is a Multiplayer Online Game that multiple players can interact with 3D version of the life of Oakland 7th Street half a century ago, and learn music and cultural histories of West Oakland. The project has been a joint effort by graduate students in the UC Berkeley Architecture Department, Digital Design Research Group led by Professor Yehuda Kalay and Graduate School of Journalism led by Professor Paul Grabowitz.

1.5 Dissertation Structure

This dissertation does not claim to solve all the challenges implicated in the development of Multiplayer Digital Game Learning Environment but, rather, suggests some practical applications of the design of more effective and engaging interactive learning environment.

The rest of this dissertation is comprised of the following chapters: Chapter 2 examines the several different learning theories on how people learn. This chapter is broken into two sections: 1) what is Learning, and 2) what is Learning Experience. Chapter 3 provides a definition for Learning Environment and identifies the elements of Learning Environment. Chapter 4 examines how different instructional media change the way young people learn and how game structure could help to design the learning activities in Virtual Environment. Chapter 5 explores the idea of adapting a multiplayer digital game environment as a new learning environment. Chapter 6 provides the design process and development of Virtual West Oakland (VWO) as a case study for building a new learning environment. Chapter 7 discusses design implications and provides guidance regarding what needs to be considered to achieve the goals of making multiplayer digital game learning environments. Chapter 8 concludes the research and discusses future direction of the study.

[7] Non-Player Characters (NPCs) are characters that are not controlled by the player. These characters are developed by the game developer and controlled by the game's artificial intelligence (AI) engine. NPCs exist for the player to interact with in some way. Discussed in more detail in chapter 5.

Chapter 2 Learning Theories

2.1 Literature Review

Learning means quite different things to different people. For instance, does what some educators regard as learning, the memorization of information, really constitute learning if the learner does not have the ability to apply that information correctly given a range of contexts? Have they learned if they can produce a fact, but cannot accurately cross-reference that piece of information with something previously 'learned'? A learner who can recite every bone in the human body cannot necessarily diagnose a problem with a given bone, nor know how to splint one if an accident occurred. Even if taken through a number of steps necessary in splinting a bone, it's unlikely that a person would do it correctly without having experienced it either first-hand, or vicariously, by observing another person in the learning process, Lave and Wenger (1991) refer to as 'legitimate peripheral participation[1]'. There is a huge disconnect between knowing something in the abstract and being able to make that knowledge actionable. In fact, emerging ideas about learning are beginning to suggest that learning is the act of making knowledge tangible through action.

The question before becomes, how can we design experiences that allow learners to experiment with knowledge in context, encouraging them to form connections by experiencing a wide range of experiential possibilities around any given piece of information?

Before addressing how learning environments should be designed, we will examine the theoretical assumptions of how people learn. Learning theories are lenses through which we view and think about the learner and learning environment. Learning theories help designers determine what instructional methods, strategies, and tactics are appropriate and how situate them within the overall learning environment. The challenge of creating a comprehensive definition of learning lies in the different interpretation of both the intent and method of learning. The following describes some of the commonly accepted learning theories that attempt to describe how we learn.

2.1.1 Behaviorist Learning Theory

Behaviorism was an approach driven by an attempt to treat psychology as an objective science. To do this, behaviorists focused only on directly observable, measurable events and behaviors, and how the environments that people live in influences their behavior. Consequently, they rejected theorizing about 'mental events' to explain why we do the things we do.

The behaviorist was not concerned with how and why knowledge is obtained, but rather if the correct response is given. Drawing on the empiricist tradition, behaviorists conceptualized learning as a process of forming connections between stimuli and responses. Motivation to learn was assumed to be driven primarily by drives, such as hunger, and the availability of external forces, such as rewards and punishments (Thorndike, 1913; Skinner, 1950).

[1] Learning viewed as situated activity has as its central defining characteristic a process. Learners inevitably participate in communities of practitioners and that the mastery of knowledge and skill requires newcomers to move toward full participation in the socio-cultural practices of a community.

Behaviorist learning tends to be passive, knowledge is objective, and evaluation is based on observable behavior. This is consistent with the traditional view of learning that was based on the mastery of isolated facts and skills learned through memorization and rote practice (Knuth & Jones, 1991). It views the mind as a "black box" in the sense that response to stimulus can be observed quantitatively, methodologically having decided to ignore the thought processes occurring in the mind.

The missing factor in behaviorist explanations is the importance of the learner's thoughts, beliefs, and interpretation of a situation. The development of appropriate social behavior is more likely if the learners understand why they are being treated in a particular way (Huesmann et al., 2003). It is an oversimplification to propose that learners can only learn through direct experience and contingent rewards.

2.1.2 Social Learning Theory

Social learning theory focuses on the learning that occurs within a social context. Whilst accepting the behaviorist's view that we learn to do what we do because of the direct reinforcement of our responses to stimuli, Albert Bandura, a Canadian psychologist, recognized that we learn also by observing the consequences of other people's actions. He acknowledged the role of observing others experiencing reinforcement and punishment, but argues that its role was in influencing which behaviors learners attend to in the first place, and also in affecting learners' motivation to reproduce a behavior. Bandura said, "Most human behavior is learned observationally through modeling: from observing others, one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action" (Bandura, 2001). Social learning theory explains human behavior in terms of continuous reciprocal interaction between cognitive, behavioral, and environmental influences.

Environment refers to the factors that can affect a person's behavior. There are social and physical environments. Social environment include family members, friends and colleagues. Physical environment includes the size of a room, the ambient temperature or the availability of certain items. Environment and situation provide the framework for understanding behavior. The situation refers to the cognitive or mental representations of the environment that may affect a person's behavior. The situation is a person's perceptions of the space, time, physical features and activity (Glanz, Rimer, & Lewis, 2002).

Bandura proposed a model of reciprocal determinism in which "behavior, cognitive and other personal facts, and environmental influences all operate interactively, as determinants of each other (p.23). Essentially, what Bandura was trying to illustrate with this model is that we are not simply reactive organisms but that we have the ability to actively alter our environment and our behavior (1998)(Figure 2.1).

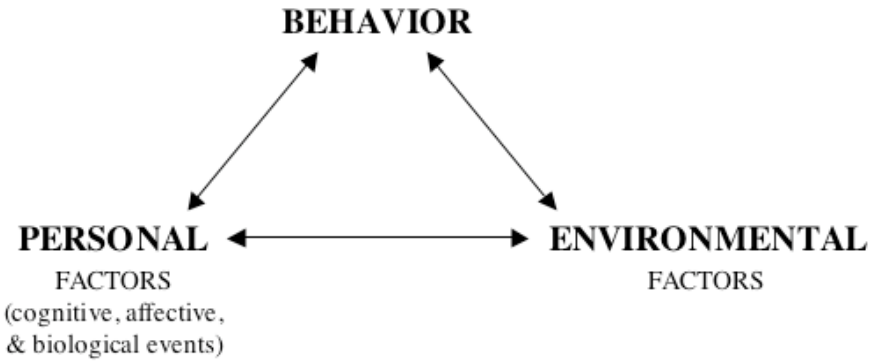

Figure 2.1 A Model of Social Learning Theory

Consider the following interdependencies and their modes of reciprocity. In considering the dynamics between the individual and behavior, behavior depends on elements such as the individual's expectations or goals. Similarly, behavior can be conditioned, thus influencing the individual. Individual achievement can be hindered by environmental inputs such as socioeconomic factors; these effectively limit the individual's access to certain developmental opportunities. However, just as the environment effects individuals, so individuals can also affect their environment; a strict boss, for example, can alter the environment of a room with their only action being their entry into the room. Our behaviors also determine our environment. In our daily lives, our environment may be quite limited, consisting only of our work or home settings. Similarly, since our environment is not static one, it can have an effect on our behavior.

Bandura's work shows that learning can occur without the sorts of reinforcement that behaviorists see as essential, and that learners are active participants in their learning. The sort of learning that Bandura highlighted goes further than simple mimicry. It implies that learners extract general principles from what they observe. However, it does not tell us about the nature of the learners' thinking or give us an insight into the process of cognitive change occurring within the learner. Moreover, it still places the emphasis on factors that are external to the learner as key influences on their developing behavior; in this case the behavior and experiences of people around them. To understand cognitive development, a different theoretical perspective is needed, namely constructivism.

2.1.3 Symbolic Interaction Learning Theory

Symbolic interaction theory posits that human actions are based on the meanings we attribute to things and these meanings emerge through social interaction (Blumer, 1969). People learn identities and values through the socialization process as they learn the social meanings that different behaviors imply. Symbolic interaction theory emphasizes that human beings make conscious and meaningful adaptations to their social environment.

Two theorists have greatly influenced the development of symbolic interaction theory: Charles Cooley (1864-1929) and George Herbert Mead (1863-1931). They saw the self-developing in response to the expectations and judgments of others in their social environment. The self is our concept of who we are and is formed in relationship to others. Cooley (1902) suggested that we learn to view ourselves as we think others view us and he called this the *looking-glass self*. The

development of the looking-glass self emerges from (1) how we think we appear to others; (2) how we think others judge us; and (3) the feelings that result from these thoughts.

Cooley explained that our self-concept is not merely a mechanical reflection of those around us; rather it rests on our interpretations of and reaction to those judgments. We are actively engaged in defining our self-concept, choosing whose looking-glass we want to pay attention to and using past experiences to aid us in interpreting others' responses. This means that the formation of the self is fundamentally a social process that is based in the interaction people have with each other. Also, subjective interpretations are important determinants of the self-concept. People interact through the medium of symbols (words and gestures) that must be subjectively interpreted and these interpretations have real consequences.

Role taking concept was proposed by George Mead (1934). Mead explained roles are the expectations associated with a given status in society and the basis of all social interaction, and we learn social norms through the process of role taking. This means imagining ourselves in the role of others in order to determine the criteria others will use to judge our behavior.

Mead described the self develops through three stages (1934). First is the preparatory stage, within which the infant is prepared to use language. The purpose of language is to communicate, which can be thought of as occurring on two different levels. Most communication between animals involves gesture. On the human level, gestures have meaning, but the meaning is not precise enough to build an elaborate language system. Thus, communication in the preparatory stage is through the gestures. A gesture can be defined as any part of a social act that is a sign for something else. There is rich communication between parents and their infant through touches, smiles and frowns, and these are examples of communication at the gesture level.

The second level of communication is a communication of significant symbols. Mead thought that a language system can develop only when oral gestures become significant symbols. A significant symbol is a gesture that has the same meaning for the creature giving it as for the creature receiving it. Parents begin to communicate with their children through gestures-a smile or a warning glance. Words accompany the gesture, and thus children learn the meaning of a word in the context of specific situations in parent's perspective, then gradually its general meaning. Children develop self-concept in much the same way; they learn to see themselves from their parents' perspective and to evaluate their behavior from parents' point of view. Children develop their self-concept by internalizing their parents' attitudes toward them.

When children are able to communicate through significant symbols, they have entered the second stage of development, the play stage. During the play stage, children limited to taking on the role of others whom they have close personal relationships, like parents and siblings. In the process, they come to view themselves as they think others view them. Increasingly, there is a sharpening of the child's sense of self as distinguishable and separate from others.

The third stage is the game stage. As children mature and participate beyond this close and familiar network, the process of role taking is expanded to larger network that helps them understand what society in general expects of them. Eventually, they come to judge their behavior not only from the perspective of significant others but also from what Mead calls the

generalized other – the composite expectations of all the other role players with whom they interact. Being aware of the expectations of the generalized other is equivalent to having learned the norms and values of the culture.

Symbolic interaction involves a series of interactions that resemble what Piaget defined in the dual processes of accommodation[2] and assimilation[3] (the cognitive constructive theory will be discussed in more detail later in this chapter). As with Piaget's developmental theory, symbolic interaction focuses upon the child being actively engaged in the process of learning through his or her interactions and experience in life. Symbols greatly aid in the knowledge acquisition process, for they help learners name, classify, and remember objects encountered in the environment. They also increase the learner's ability to think and perform problem-solving activities and help learners be more active rather than passive as they interact with others and the environment. Symbol sharing is intimately tied to knowledge sharing, knowledge representation, and the development of individuality within the context of a social environment.

2.1.4 Constructivist Learning Theory

Constructivist learning is viewed as constructed by the learner through a learning process. The knowledge is not transmitted from one person to another but has to be constructed by the individual. Constructivist knowledge is relative rather than absolute and can vary according to time and space. The evaluation of constructivist learning is different from traditional evaluation since the focus is on the individual progress that takes place during the learning process. The constructivist view of reading, for example, suggests that readers construct meaning by making inferences and interpretations and learn by linking new information to prior knowledge (Knuth & Jones, 1991). Experiential constructivist theory emphasizes learning through experience. Cognitive constructivist theory emphasizes learning through exploration and discovery. Socio-cultural constructivist theory emphasizes learning through collaboration between groups of learners. Lastly, Situated constructivist theory emphasizes learning through experience in context of real-world.

1) Experiential Constructivist Learning and Dewey

John Dewey, arguably one of the most influential educational theorists of the 19th century, exhorted educators to incorporate the interests of the child into the curriculum, making the child the center of the school (1938). Dewey's philosophy of education rested on the meaning of experience. Dewey argued that there is an organic connection between education and personal experience. Dewey rejected the transmission of knowledge of the past as the endpoint of education and only emphasized its importance as a means. Dewey tried to discover the connection between what actually exists within experience and between the achievements of the past and the issues of the present. His purpose was to ascertain how knowledge of the past might be translated into a potent instrumentality for dealing effectively with the future. Dewey stated that, "education is a development within, by, and for experience" (Dewey, 1938, p.17). By this he meant that not all of experience is educative. It is only by means of experience, by interacting with one's environment, that a person becomes educated. The goal of education, its ultimate

[2] The cognitive process that occurs when a person changes his/her theories of how the world in response to a piece of information that his/her current theories cannot handle.

[3] The cognitive process by which a person integrates new perceptual, motor, or conceptual matter into existing schemata or patterns of behavior.

payoff, is not higher scores on this or that test, nor is it increased feelings of self-esteem or the development of psychological powers of this or that kind, nor is it preparation for a future vocation. Instead, the true goal of education, is richer and fuller experiencing; the ever-expanding capacity to appreciate more fully the living present.

In developing a theory in order that education may be intelligently conducted and built on the basis of experience, Dewey concentrated on two aspects that provided the measure of the educative significance: the principle of continuity and the principle of interaction. According to Dewey (1938), the two principles are not separate from each other. The principle of continuity is the longitudinal aspect of experience and interaction is the lateral aspect of experience. The principle of continuity is involved "in every attempt to discriminate between experiences that are worth while educationally and those that are not" (Dewey, 1938, p.24). Every experience lives on in further experiences. Hence the central problem of an education based upon experience is to select the kind of present experiences that live fruitfully and creatively in subsequent experiences. Of course, students in traditional education have experiences. But traditional education offers the wrong experiences in that experiences without connection are not linked to further experiences. As Dewey states, "The principle of continuity of experience means that every experience both takes up something from those which have gone before and modifies in some way the quality of those which come after" (Dewey, p.27).

In addition to the concept of continuity of experience, Dewey focused on "growth, or growing" in order to get at the basis of discriminating among experiences. Thus, the educative process can be identified with growth. However, growth might take many different directions, and growth itself is not enough. We must specify the direction in which growth takes place, the end towards which it tends. Dewey argued that criterion of education as growing should be universally applicable, not specialized and limited to a particular line. Dewey notes "experience doesn't occur in a vacuum" (p. 34). Experience does not occur simply inside a person. There are sources outside an individual that give rise to experience and external conditions always affect educational experiences.

The category of interaction addresses the situated character of experience. It says that there is always some kind of interchange occurring between us, as organisms and our environments. We act upon the world and the world acts upon us. This interactive condition in which we find ourselves and in which we participate forms the situation we currently inhabit. Moreover, a crucial set of elements within that interactive mix includes all that we bring to the situation in the way of knowledge, needs, purposes, interests, the residue of past experience, our readiness to respond in this way or that, and so forth. According to Dewey, interaction assigns "equal rights to both factors in experience-object and internal conditions" (pp.38-39). Also, he says, "any normal experience is an interplay of these two sets of conditions. Taken together, or in their interaction, they form what we call a situation" (p.39). As a result, the individuals always live in "the series of situation" (p.41), and the conceptions of situation and of interaction are inseparable from each other. Thus, as experience continues, further experience (or growth), creates new situations through the interaction with the environment. Every experience influences the objective conditions under which further experiences occur and are influenced by objective conditions.

2) Cognitive Constructivist Learning and Piaget

Cognitivist learning takes place through active mental processes where knowledge is considered as abstract symbolic mental construction that is processed in the learner's memory. Learning is active and takes place through information processing; the theory is consistent with the "input-processing-output" computerized model. The evaluation of cognitivist learning is based on observable behavior and achievement of intended objectives. The cognitivist view of reading involves active reading, using a variety of strategies, with interaction among the reader, the text, and the context (Knuth & Jones, 1991).

Jean Piaget was one of the most influential researchers in the area of cognitive development and learning. Piaget, as a biologist, became interested in how an organism adapts to its environment (which he described as intelligence); the process of coming to know and the stages we move through as we gradually acquire this ability (Gross, 1985). To Piaget, learning is an active process and a progressive reorganization of mental processes as a result of maturation experiences based on interaction with physical and social environments.

Piaget spoke of concepts and ideas constructed in specific sequences of stages, progressing from concrete action-oriented experiences to internalize, symbolic modes. Central to Piagetian theory is the principle that intellectual growth results from interactions with experiences in the learner's environment, progressing through three phases: a) exploration (assimilation and disequilibrium); b) conceptual invention (accommodation); and conceptual expansion (organization). The results of many of Piaget's education experiments lent significant credence to the theory that concrete experiences with phenomena in their varying context should precede categorization, explanations, terminology, and conceptualization (Piaget, 1963; Aldrige, 1992).

According to cognitive scientists, there are three factors that influence the development of mental structures: experiences with the environment, maturation, and the social environment.

Experience with the environment is essential since the interaction with the environment is how new structures are made. Piaget distinguishes between two types of experiences, namely concrete (physical) and abstract (logico-mathematical). It is important to remind ourselves that knowledge is constructed through experience, but the type of knowledge will be dependent on the type of experience the individual is engaged in. Concrete experiences are physical experiences in which consists of acting upon objects in order to abstract their properties. In other words, a direct encounter with physical objects was essential to the development of thinking. Abstract experiences are logico-mathematical experiences in which consists of acting upon objects with a view to learning the result of the coordination of the actions. In other words, knowledge can be constructed from thinking about experiences with objects and events (Gallagher & Reid, 1981). The child invents abstract knowledge; it is not inherent in objects, as physical experience is, but constructed from the actions of the child on objects. The objects serve merely as a medium for permitting the construction to occur. Number concepts are examples of abstract experiences.

Learners need more than experience with the environment, and they also need to interact socially. Here the role of language, and verbal interaction in the social environment will accelerate or retard cognitive development. The crucial aspect of this fact is that learners be given the opportunity to examine and discuss their present beliefs and conceptions.

The third factor facilitating the process of self-regulation is maturation. Piagetian theory is developmental, thereby placing importance on the maturation level of the learner.

Piaget suggested that there are four general stages in cognitive development: sesorimotor (birth to 2 years), preoperation (2-7 years), concrete-operational (7-11 years), and formal-operational (11-15 years).

- During the sensorimotor stage, according to Piaget, knowledge about the world is primarily perceptual. Things are known as they are experienced and toward the end of the second year of life, child will end the period with a capacity to form primitive symbolic representations of behavior.
- During the preoperational stage, intellectual behavior moves from the sensorimotor level to the conceptual level. Rapid representation and language development facilitate the further development of social behavior.
- During the concrete-operational period, a child develops the use of logical thought. The construction of a concept of intentionality emerges and allows children to begin to consider the motives of others when making moral judgments.
- During the formal operational period, cognitive structures (schemata) become qualitatively "mature". A child becomes structurally able to operate on the logic of an argument independent of its content.

At each new level of cognitive development, previous levels are incorporated and integrated. The processes of assimilation and accommodation permit the continuous construction of cognitive structures. Schemata are continually modified throughout life, from birth onward. While changes in capabilities for logical reasoning cease after the development of formal operations, changes in content and function of intelligence continue. That is, people continue to develop concepts, areas of content, and purposes to which their reasoning can be applied.

Thus, early sensorimotor development is the foundation on which later conceptual development is built. The basic paradigm of cognitive development for Piaget is the assimilation and accommodation of experience, resulting in qualitative structural changes in cognitive structures (schemata).

In summary, Piaget's theory offers a rich description of a child developing a more abstract and general capacity to tackle problems in the world, in a very independent way. Piaget argued that children reason differently to adults, as their mental representations of the world are initially centered on their own perceptions and experiences of it. Cognitive development occurs as children become able to act on their environment in increasingly sophisticated way. Children are, therefore, seen as active in constructing their understanding of the world from an initial set of innate behaviors.

His ideas were used to support the pedagogic principles of discovery learning, in which the provision of a rich learning environment is seen as essential, rather than direct tuition. In this approach, learners are given opportunities to actively explore and investigate concepts and physical events in order to build their understanding. According to the main tenets of discovery

learning, teaching needs to encourage self-directed investigation rather than a potentially superficial understanding in imitation of adult performance.

The relative lack of attention paid to the social and cultural context of child development has been a substantial criticism of Piaget's ideas. One of Piaget's critics on this point was a Russian contemporary, Lev Vygotsky.

3) Socio-Cultural Constructivist Learning and Vygotsky

The socio-cultural approach to learning was applied by L. S. Vygotsky. Vygotsky's main concern was that social interaction and social context—a world full of other people who interact with the child from birth onwards—are essential in cognitive development. He states that "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals." (Vygotsky, 1978, p 57).

Next, he points out the idea that the potential for cognitive development is limited to a certain time span, which he names the "zone of proximal development" (ZDP). In addition, full development during ZDP depends upon full social interaction. The range of skill that can be developed with adult guidance or peer collaboration exceeds what can be attained alone. In a wide range of ways, adults mediate the world for children and make it possible for them to get access to it. The ability to learn through instruction and mediation is characteristic of human intelligence. With the help of adults, children can do and understand more than they can on their own (Cameron, 2002, p 5-8). Vygotsky proposed the notion of ZPD to give a new meaning to 'intelligence'. Instead of measuring intelligence by what a child can do alone, he suggested that intelligence could better be measured by what a child can do with skilled help.

Vygotsky attempted to shed light on consciousness that develops as the result of socialization. While learning a language the first utterances have a communicational purpose, but internalized they become "inner speech". Young children can often be observed talking to themselves and act as if they carry out tasks or play in what is called private speech. As children get older they gradually speak less and less out loud, and differentiate between social speech for others and 'inner speech', which continues to play an important role in regulating and controlling behavior. Wertsch (1985) emphasizes that internalization for Vygotsky was not just transfer but also a transformation; being able to think about something is qualitatively different from being able to do it. In the internalizing process, the interpersonal, joint talk and joint activity later becomes intrapersonal, mental action by one individual. Development can be seen as internalizing from social interaction. Language can grow as the child takes over control of language used initially with other children and adults.

Vygotsky focused on the connections between people and the socio-cultural context in which they act and interact in shared experiences (Crawford, 1996). According to Vygotsky, humans use tools that develop from a culture, such as speech and writing, to mediate their social environments. Initially children develop these tools to serve solely as social functions, ways to

communicate needs. Vygotsky believed that the internalization of these tools led to higher thinking skills.

Many schools have traditionally held a transmissionist[4] or instructionist[5] model in which a teacher or lecturer 'transmits' information to students. In contrast, Vygotsky's theory promotes learning contexts in which students play an active role in learning. The roles of the teacher and students are therefore shifted, as a teacher should collaborate with his or her students in order to help facilitate meaning construction in students. Learning therefore becomes a reciprocal experience for the students and teacher.

4) Situated Constructivist Learning

One important constructivist educational model is termed situated learning (Brown et al., 1989; Lave, 1988). A fundamental concept of situated learning is that all earning takes place in a specific context and that context significantly impacts learning (Alessi & Trollip, 2001). When learning is removed from its context, the value of the knowledge and the relevance of that knowledge to the learner depreciate (Duffy & Cunningham, 1996). This contrasts with most classroom learning activities, which involve abstract and out-of-context knowledge and deliberate learning. The impact of this dichotomy on the learner is often reduced motivation and cognitive dissonance (Henning, 1998). Situated learning involves a practice-based approach that tends to erase the dichotomy between school-based learning and real-world learning. Because situated learning can take place in settings that are culturally and socially diverse, the learning environment can be dynamic (Duffy & Cunningham, 1996). Consequently, situated learning need not employ the linear approach to instruction that is most commonly used in a classroom setting.

By embedding subject matter in the ongoing experiences of the learners and by creating opportunities for learners to engage in subject matter in the context of real-world challenges, knowledge is acquired and learning transfers from the classroom to the realm of practice. To situated learning means to place thought and action in a specific place and time. To situate means to involve other learners, the environment, and the activities to create meaning. To situate means to locate in a particular setting the thinking and doing processes used by experts to accomplish knowledge and skill tasks (Lave & Wenger, 1991).

Learning in a design studio is a perfect setting for situated learning. Schon (1992) argues that design processes involve conversations between the designer and the situation and in a good process of design the conversation with the situation is reflective. In answer to the situation's 'back-talk", the designer "reflects-in-action" on the construction of the problem, the strategies of action, or the model of the phenomena, which have been implicit in his moves. Moves involve understanding and interpretation of a new situation and making conclusions rather than the reproduction of knowledge. From the outset of a design task, designers create their early moves

[4] In transmission model, the brain serves to *transmit*, rather than to originate, conclusions, and hence that consciousness may exist independently of the brain.

[5] In instructionist model, there is a predictable and reliable link between the instructional materials, the stimulus, and the learning that is observable in the learner, the response, resulting from the interaction with the learning material.

in accordance with an initial design appreciation. The move then might produce some unexpected consequences, which might lead to some new situations.

Situated learning places the learner in the center of an instructional process consisting of content (the facts and processes of the task), context (the situations, values, beliefs, and environmental cues by which the learner gains and masters content), community (the group with which the learner will create and negotiate meaning of the situation), and participation (the process by which learners working together and with experts in a social organization solve problem related to everyday life circumstances) (Brown, Collin, & Duguid, 1989; Lave, 1988). Learning becomes a social process dependent upon transactions with others placed within a context that resembles as closely as possible the practice or real environment. Situated learning in the classroom integrates content, context, community, and participation.

a. Content

Situated learning emphasizes higher-order thinking processes rather than the acquisition of facts independent of the real lives of the participants (Choi & Hannafin, 1995). Content situated in learner's daily experiences becomes the means to engage in reflective thinking. Retention of content is not the goal of learning. By placing content within the daily transactions of the life, the instructor, in dialogue with learners, negotiates the meaning of content, frames it in terms of the issues and concerns of the learners, provides opportunities for learners to cooperate in investigating problem situations, and makes content applicable to the ways in which the learners will approach the environment. Application rather than retention becomes the mark of successful instructional encounter.

b. Context

Learning in context refers to building an instructional environment sensitive to the tasks that learners must complete to be successful in practice. Context embraces the notion of power relationships, politics, competing priorities, and the learner's interaction with the values, norms, and culture of a community, organization, or family (Courtney, Speck, & Holtorf, 1996). Boud (1994) describes context as drawing out and using experiences as a means of engaging with and intervening in the social, psychological, and material environment in which the learner is situated. Context is not just bringing life events to the classroom but re-experiencing events from multiple perspectives. Learners are brought into the experience rather than being external to the event (Wilson, 1993). Context provides the setting for examining experience; community provides the shaping of the learning.

c. Community of practice

Through community, learners interpret, reflect, and form meaning. Community provides the setting for the social interaction needed to engage in dialogue with others to see various and diverse perspectives on any issue (Brown, 1994; Lave & Wenger, 1991). Community is the joining of practice with analysis and reflection to share the tacit understandings and to create shared knowledge from the experiences among participants in a learning opportunity. Community also refers to the body of knowledge created by an individual entering an area of inquiry; Jacobson (1996) identifies practitioner knowledge and cultural knowledge as communities in which a new member must learn to perceive,

interpret, and communicate experience through interaction with other members of the community. Community provides opportunity for the interaction; participation provides the learner with the meaning of the experience.

d. Participation

Participation describes the interchange of ideas, attempts at problem solving, and active engagement of learners with each other and with the materials of instruction. It is the process of interaction with others that produces and establishes meaning systems among learners. From a situated cognition perspective, learning occurs in a social setting through dialogue with others in the community (Lave, 1988). Learning becomes a process of reflecting, interpreting, and negotiating meaning among the participants of a community. Learning is the sharing of the narratives produced by a group of learners.

2.2 Summary of Learning Theories

Theory serves a dual purpose of explaining phenomena (or more accurately, sense and meaning making) and of providing guidance for decision making or action. Three prominent learning theories seek to provide insight into the act of learning; behaviorism, social learning, symbolic interactionism, and constructivism:

- Behaviorism – learning through discipline
- Social Learning – learning through social context
- Symbolic Interactionism – learning through socialization process
- Experiential Constructivism – learning through experience
- Cognitive Constructivism – learning through *natural stages*
- Socio-Cultural Constructivism – learning through interaction
- Situated Constructivism – learning through *natural context*

When all these different schools of thought are analyzed closely, many overlapping ideas and principles become apparent. For example, all the theories value the environment the child develops within, although they differ in the extent to which they see the environment as central and what aspects they see as of key significance. Behaviorism is perhaps the most extreme 'empiricist' position, but the environment is also seen as important in each of the other: 'environment' in the sense of other people and their behaviors (Social Learning); environment as the context, shaper, and object of action and interaction (Symbolic Interactionism); environment as the world of experience (Experiential Constructivism); environment as affording opportunities for exploration and therefore cognitive development (Cognitive Constructivism); environment as cultural and social interaction (Socio-Cultural Constructivism); and environment as contextual source of social and physical information (Situated Constructivism). Learning takes place when a learner (person) interacts with, or is stimulated by an environment (Lewin, 1951). (Further discussion on this topic in Chapter 3)

Moreover, all the theories also value the social interaction as the main method of obtaining the knowledge, although they differ in the extent to which they see how interaction occurs, in terms of 1) where it happens, 2) who is involved, and 3) what form of interaction. All the theories agree that social interaction with peers is a must for learning.

Based on the learning theories that I have discussed, I believe that the best approach to designing learning environments is to support the learners in the creation and transfer of context-dependent, flexible and adaptive learning in a socio-cultural environment. The following guiding principles are the attempts to describe what should be the ideal learning environment.

a. Active Principle

Learners should be mentally involved in learning activities, generating connections between what they already know and what they are being asked to learn and constructing meaning from their experiences. Therefore, meaningful learning occurs as the result of the learner's activity during learning.

b. Meaningful Principle

Meanings are not general or de-contextualized. Learning is enhanced when the learner is able to meaningful link new information to prior knowledge and experience.

c. Achievement Principle

The learner's ongoing achievements should be encouraged. For learner of all levels of skill one should develop intrinsic rewards from the beginning, customized to each learner's level, effort, and growing mastery.

d. Competence Principle

The learner should have ample opportunity to operate within, but at the outer limits of, his or her resources, so that the learner is face with challenging but not impossible tasks.

e. Transfer Principle

Learners must have many opportunities to practice, and must have support for transferring what they have learned previously to later problems, including problems that require adapting and transforming that earlier learning.

f. Collaborative Principle

Meaning is understood from multiple perspectives. Conceptual learning comes from the sharing of multiple perspectives and the simultaneous changing of our internal representation in response to those perspectives.

g. Situated context Principle

Learning must be situated in a rich context, reflective of the world.

h. Reflective Principle

Learning is facilitated when students get feedback about their thinking, whether that feedback comes from within, a teacher, or a peer. Then, provided the opportunity for revision, students can achieve at higher levels and reach a deeper understanding.

i. Control and Choice Principle

When learners work at their own comfort level, they can foster ownership of the activities.

j. Community Principle

Learning should be in such a way that supports the social and cultural realms of group interaction, peer and mentor relations, group culture, and the environmental influences of tools, settings, and techniques.

k. Motivation Principle

Learning requires motivation. The act of being motivated is to want to find out certain things, to have a desire for knowledge, to like learning and to keep on learning even if its relevance is not immediately clear.

In summary, learning is not simply a passive response to the instruction's "delivery", as the behaviorists argue. Rather learning is an active, constructive, cognitive, and social process by which the learner strategically manages available cognitive, physical, and social resources to create new knowledge by interacting with information in the environment and integrating it with information store in memory (Shuell, 1998). From this perspective, knowledge and learning are the result of a reciprocal interaction between the learner's cognitive resources and aspects of the external environment.

2.3 Learning Experience

From these literature reviews, what stands out most, though, is that all the theories find *the experience* as a key player in the learning process. Learning is a process of active engagement with experience. The behaviorist approach emphasizes learning is a relatively permanent change in behavior due to experience. This refers to a change in behavior, an external change that we can observe. Central to Piagetian theory (Cognitive constructivism) is the principle that intellectual growth results from interactions with experiences in the learner's environment, progressing through three phases: (a) exploration (assimilation and disequalibrium); (b) conceptual invention (accommodation); and (c) conceptual expansion (organization). The results of many of Piaget's education experiments lent significant credence to the theory that concrete experiences with phenomena in their varying contexts should precede categorization, explanations, terminology, and conceptualization (Aldridge, 1992; Piaget, 1963). Vygotsky's socio-cultural theory is the notion that social experiences shape the ways that the learners think and interpret their world. According to situated constructivists, there is significant evidences that experiences can provide learners more authentic contexts generate greater occurrences of higher-order process skills. Also students are more motivated because of genuine interest - learning to define concepts in order to communicate effectively and becoming adept in planning and completing complex investigations. And above all, Dewey argued that experience is what knowledge starts from, and is its ultimate arbiter. Experience itself is not knowledge; we get knowledge only after inquiring into our experience.

The role of experience in education has a history that connects back to philosophical debates between rationalists and empiricists. Rationalists, represented by Descartes and Leibniz, argued that the information that is gained through one's senses is unreliable, and the only reliable knowledge is that which is gained through reason alone. Empiricists, represented by Locke, Berkeley, and Hume, argued that knowledge is derived from empirical sense impressions, and abstract concepts that cannot directly be experienced cannot be known. In 1787, the German philosopher Immanuel Kant resolved the debate by arguing that both rationality and experience have a place in the construction of knowledge. Indeed, the human mind imposes order on the experience of the world in the process of perceiving it. Therefore, all experiences are organized by the actively structuring mind.

Dale (1946) saw learning experiences could be classified in a number of ways. All experience in its initial manifestation must enter through one or more of the senses. Dale converted this phenomenon into what he called 'the Cone of experience' (Figure 2.2). Later Bruner (1966) provided a way for subdividing these stages into three modes – enactive (direct experience),

iconic (pictorial experience), and symbolic (highly abstract experience) – representing the forms that knowledge and understanding can take and the order these develop in a person.

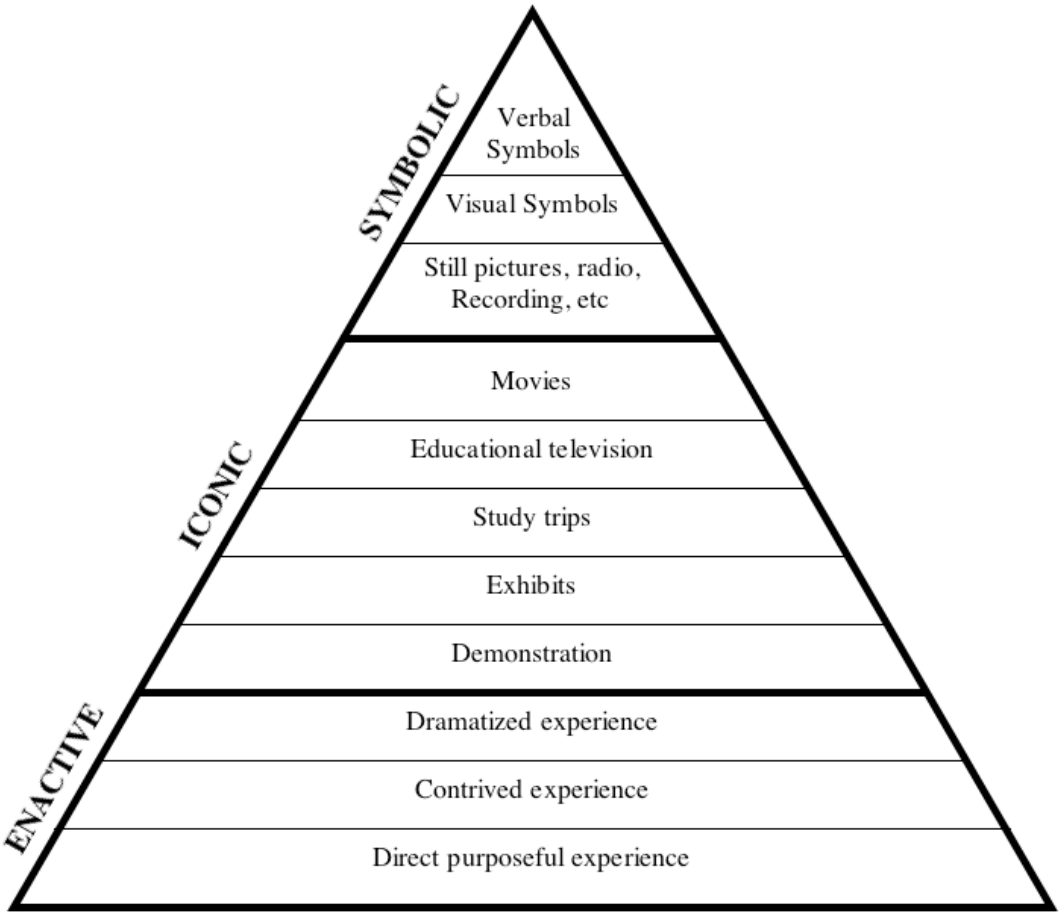

Figure 2.2 E. Dale's Cone of Experience (Dale, 1946)

Taking the Cone as Dale conceived it and Bruner revised it, it represents a series of relationships which are connected on a continuum from the most concrete to the most abstract. Starting at the base, 'direct, purposeful experience' is the most concrete, active, multi-dimensional, multi-sensory experience which we can have. Such experiences are real. Not only are we present and taking part in some way but the context is 'real': a real game in which we are either playing or spectators, a real job for money and so on. As one's eyes travel up the Cone, two things happen: the Cone gets narrower, reflecting the degree of abstraction, and the extent of sensory and active input decreases. As we go up the curve some aspect of our relationship to 'reality' changes, but the situation is still an 'experience.' So a contrived experience is almost real, like a training ground, or a simulation, such as a flight simulator; a dramatized experience is a role play which mimics reality but is still role play; and so on up the Cone with decreasing sensory or physical breadth until we come to the most abstract, mono-dimensional, single sensory experiences at the top.

Dale describes the Cone of Experience as follows: "The individual bands of the Cone of Experience stand for experiences that are fluid, extensive and continually interacting. The Cone

uses these separate bands for organizing instructional materials according to the sort of experience each provides." As such the model values and encourages variety and flexibility in what is deemed to be experience and is easily adapted to take into account the change in training patterns and the growth in technological developments and telecommunication which have occurred more recently. Consequently, we can add to Dale's original list work experience and placements (enactive mode); the Internet, CD-ROM, virtually reality programs and video cassettes (iconic mode) and word processing (symbolic mode) (Figure 2.3).

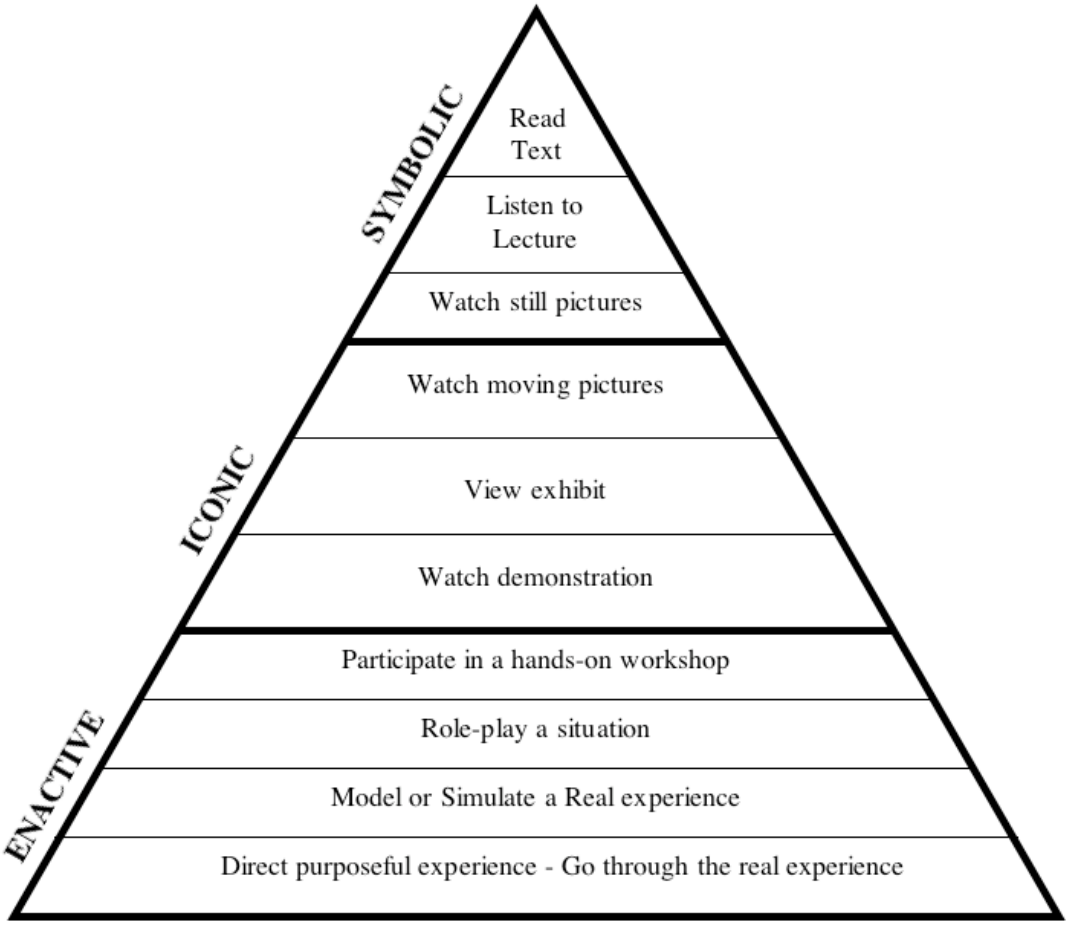

Figure 2.3 Adapted from E. Dale's Cone of Experience (Dale, 1946)

Dale believed that abstract symbols and ideas could be more easily understood and retained by the learner if they were built on a more concrete experience, enactive mode. " A well educated person has a mind stacked with a rich variety of concepts, grounded in concrete personal experiences. And such experiences are classifiable through a pictorial device a metaphorical 'cone of experience'" (Dale, 1946, pp.51-52).

Dale, however, also emphasized the creating rich *combinations* of concrete and abstract experiences: "Abstraction s must be combined, if we are to have rich, full, deep, and broad experience and understanding. In brief, we ought to use all the ways of experiencing that we can" (Dale, 1946).

As Dale argued, the Cone of Experience does not represent a literal progression from the concrete base to the abstract pinnacle. We do not literally progress through the cone's levels. The cone represents a range of experiences through which we learn, and various levels are complementary. Modes of experiences are fluid, and learning often involves all three major modes – enactive (direct experience), iconic (pictorial experience), and symbolic (highly abstract experience) – at once. Our richest sense impression involving feelings and perceptions are formed as we explore the world. We call this lively, embodied participation our bedrock for learning. Through the five senses, or what Dale called the "unabridged experience of life," we generate a wealth of meaningful knowledge and feelings about ourselves and our world. This is not to say that direct experiences are more valuable than iconic or symbolic experiences. All three modes are equally important in learning. We give direct experience precedence to orient the trajectory of learning from the concrete towards the abstract; the process is incomplete until we follow through to abstraction and symbolic experience. In order for learners to develop meaningful knowledge, feelings, and skills, their experiences must be 'associated with abstractions,' as Dale noted. Language and expression are essential to skill acquisition.

So then, what would be the best solution to integrate all three modes of experiences? What would be the best way to create learning environment where supports the learners in the creation and transfer of context-dependent, flexible and adaptive learning in a socio-cultural environment? Where does the use of current and new technologies play into these learning experiences?

Before addressing these questions, we still face the difficulties of translating theoretical concepts to the practical model of learning environment. There are a vast number of implementation issues to consider from the theoretical and to the practical to design of a learning environment. In fact, conceptualizing and designing a learning environment is a complex task with a multitude of variables and outcomes to consider as well as real world constraints. The following chapter will discuss the implication of what we need to consider for designing a learning environment.

Chapter 3 Learning Environment (LE)

3.1 The Concept of a Learning Environment

Until recently the term "learning environment" has been perceived as only the classroom setting in school. Learning environment in schools typically involve one or more adult teachers connected with a number of students, usually in defined physical settings.

Like the classroom metaphor, thinking of instruction as an environment gives emphasis of the "place" or "space' where learning occurs. At a minimum, a learning environment contains:

- the learner;
- a setting or "space" where the learner acts – using tools and devices collecting and interpreting information, interacting perhaps with other, etc.

An environment where students are given room to explore, and determines goals and learning activities seems an attractive concept. Students who are given generous access to information resources – books, print and video materials, etc – and tools – word-processing programs, communication tools, search tools, etc – are likely to learn something if they are also given proper support and guidance. Under this conception, learning is fostered and supported, but not controlled or dictated in any strict fashion. A learning environment, then, is a place where the resources, time, and reasons are available to a group of people to nurture, support, and value their learning of limited set of information and ideas. Learning environment are social places even when only one person can be found there.

Difficulties remain, however, with this model of a learning environment. For one thing, learning environments seem intrinsically fuzzy and ill-define. If students are involved in choosing learning activities and controlling pace and direction, a level of uncertainty and uncontrolledness comes into play. For all instructors' care and attention, the system will often appear chaotic to outside observers and even participants. In short, there seems to be a tendency toward chaos and entropy in open learning environments that are not well-designed and supported.

Another problem for this model lies in the individualist connotation of "environment." The metaphor of person-in-environment, at least in psychology, tends to isolate individuals and treat other people as other objects within the environment to be used or manipulated. The picture comes to mind of a nerdy 'surfer' of the Internet, exploring all kinds of resources, yet remaining reluctant to relate to a true peer group of learners – electronic or otherwise.

Therefore, the idea of 'learning communities' may be more appropriate in this regard. Communities of learners work together on projects and learning agendas, supporting and learning environment, an individual's tool-using and information – using activities need to be complemented by the powerful resources presented by other people and by the surrounding culture. In terms of constructivist learning, environments are places where group of learners learn to use tools of their culture – including language and the rules for engaging in dialogue and knowledge generation (Morrison & Collins, 1996).

In summary, we could start define of a learning environment then would be:

- A place where learners may work together and support each other
- As they use a variety of tools and information resources
- In their pursuit of learning goals and problem-solving activities.

3.2 *Facet* Analyses

Dewey (1938) says that, "education is not simply transmission of knowledge, but *in its broadest sense, is the means of this social continuity of life"*. The complexity of learning environment could be provided via tools and content to be learnt. In an article Educational Technology, Perkins (1991) performs a "facet" analysis of learning environments. He suggests that all learning environments, including traditional classroom, are made up of five facets: sources of information (information banks), means of expression through writing or other symbols (symbol pads), means for undertaking and receiving feedback on specific learning tasks (task managers), authentic as possible areas for trying out concepts (phenomenaria), and means of expression through manipulation of pre-existing objects (Construction kits):

a. ***Information banks.*** Sources of information. Information banks are sources or repositories of information. Examples would include textbooks, teachers, encyclopedias, videotapes, videodiscs, etc.
b. ***Symbol pads.*** Means of expression through writing or other symbols. These are surfaces for construction and manipulation of symbols and language. Examples include student notebooks, index cards, word processors, drawing programs, and database programs.
c. ***Task Managers.*** Means for undertaking and receiving feedback on specific learning tasks. In any learning environment, a function of control and supervision exists. Task managers are those elements of the environment that set tasks, provide guidance, feedback, and changes in direction. Task management is often assumed by the instructor, but in constructivist environments, students themselves assume much of this role. A variety of tools and documents support instructors and students in the management of tasks, including assignments within consultations, advisement session, strategic planning tools, textbooks, grading programs, assessment devices, devices for conveying rules and expectations, and computer-based instruction programs. Realistically, students and instructors need to negotiate the details of task management, with students assuming greater levels of independence wherever possible. In such cases, the instructor becomes a coach, advisor, and mentor to support student activities.
d. ***Phenomenaria.*** Authentic as possible areas for trying out concept. Perkins defines phenomenaria as "areas" for presenting, observing, and manipulating phenomena (aquariums, SimCity, etc.). Of course, SimCity is a simulation of real-world cities, and not the thing itself. The key idea is that aspects of the world are brought and made available to student inspection and exploration. To my understanding, phenomenaria are roughly parallel to instructional simulations. I like Perkins's term because it emphasizes the instructional nature of the simulation (contrasted to non-instructional simulation intend to scientific or technical purposes).
e. ***Construction kits.*** Means of expression through manipulation of pre-existing objects. These are similar to phenomenaria, except they are less tied to natural phenomena.

Construction kits are packaged collections of content components for assembly and manipulation. They may have no clear counterpart in the "real" world. Examples include Legos, learning logs, math-manipulation software such as the Geometric Supposer, or authoring tools such as HyperStudio.

With these identified components, Perkins distinguishes between " minimalist" and "rich" learning environments:

- ***Minimalist*** learning environments emphasis information banks, symbol pads, and task managers. A traditional classroom would be a lean learning environment with relatively few tools for manipulating and observing content, making exploring and problem solving difficult.
- ***Richer*** environments contain more construction kits and phenomenaria, and place more control of the environment in the hands of the learners themselves. Students are typically engaged in multiple activities in pursuit of multiple learning goals, with the instructor serving the role of coach and facilitator.

Perkins (1991) argues that understanding is not something that comes free with full databanks; it is something won by the struggles of the student to learn, to conjecture, to probe and to puzzle out. Thus, a shift in emphasis in needed away from the information banks and more towards construction kits or phenomemaria. The reason for this shift is because the latter facets place the learner directly and emphatically in the position of having something to make sense of or with, respectively.

Perkins also notes differences in the amount of guidance or direct instruction found in learning environments. Varying degree of guidance pose different instructional challenges for the learning environment. As the instructor relinquishes control over content, pacing, and specific activities, learners need corresponding increase in decision and performance support. Poorly planned learning environments are vulnerable to failure due to lack of support, leaving learners feeling stranded and face with unreasonable performance expectations. This problem is complicated by the fact that learners differ dramatically in their need for support.

3.3 Learners and Facilitator

3.3.1 What Kind of Learner

Although varied learning preferences can improve the chances of learning, understanding how learners process the information is also important. The different ways that learners process information are called learning styles, of which there are five: achievers, evaluators, net-workers, socializers, and observers:

- ***Achievers:*** These learners focus on doing and accomplishing results and generally have the expertise to do so. They enjoy being involved in new and challenging experiences and carrying out plans to meet those challenges. Achievers have the ability to solve problems, make decisions, and develop action plans based on implementing solutions to questions or problems. They want to find practical uses for the ideas and training content. Achievers like to accept the lead role in addressing those challenges.

- ***Evaluators:*** These learners like to analyze a situation and use a logical process to resolve issues. They ask many detailed questions and in so doing collect a great deal of information. They are very concerned about working within the existing guidelines. Evaluators are good at assimilating a wide range of information and putting it into concise, logical form, like lists. These learners are more interested in the basis of theory and application of theory and less to building relationships.
- ***Networkers:*** These learners like to develop close relationships with others and avoid interpersonal conflict. They try to avoid risks, seek consensus, and are slower than others to make decisions. In group activities, networkers rarely disagree with others' opinions, but rather are supportive of others and seek collaboration. Although they are outgoing, they need direct feedback as a way of support.
- ***Socializers:*** These learners like to talk and to share. Although they like to get multiple perspectives, they are good at selling their ideas to others and building alliances. Socializers are not concerned with details or facts. In group work, the socializer wants to work quickly, seek others' input, persuade others, get it done quickly, provide some humor, and volunteer to make the presentation.
- ***Observers:*** These learners are best at viewing concrete situation from many different points of view. They prefer to observe and conceptualize rather than take action. Observers want to take time to reflect and conceptualize and don't like to wing it.

3.3.2 Facilitator

Facilitators wear many hats during the course of a learning event, and all these hats are critical to supporting an effective learning experience. An apt analogy might be director of a play or movie: the director orchestrates everything that happens, from what they actors say and do down to physical details. These elements interact to support the goal of telling story.

By the same token, all roles facilitators fill and all the things facilitators do interact to support one goal: learning. While wearing these many hats, facilitators are also in charge of both the task (learning and applying knowledge and skills) and the process (how the learning and applying happen) of learning experiences.

As a leader, the facilitator is in charge of leading both the tasks and the process aspects of learning. In the process, facilitators: 1) lead how the group of learners interacts; 2) support the learning of the group; and 3) help learners apply the new knowledge and skills to their jobs. The facilitator also do in leading the task component is provide feedback on participants' comments and individual and group activities.

As a manager, the facilitator develops and maintains the learning agenda as a task enforcer. The facilitator manages the time to complete all the content and fully experience the learning strategies for the learner. The facilitator is to help the learners complete a critical task: to make sense of the concepts and apply them to their jobs within the context of their environment. The facilitator must help learners see the implications of new knowledge and skills for their performance.

3.4 Interactivity

Implicit in the definition of interactivity is the concept of active learning and it is key in the major learning theories as well. Interactivity is a key concept in learning environments (Sims, 1997). It refers to the interaction of a learner with the learning material, the instructor, or with peers in the process of learning (Moore, 1992). Interaction in different forms is known to be beneficial for the learning experience and the overall effectiveness of learning. However, a clear definition is still not unanimously agreed upon, which makes the ongoing concern for designing learning environment. So it is important to discuss: 1) the working definition of interaction; 2) discussion and analysis of various modes of interaction in learning.

Behaviorism, with its emphasis on conditioning and reinforcement, relies on interaction between the learner and the instructor or the learner and the environment for the stimuli that either strengthens or weakens the response from the learner. Cognitive Constructivist focuses on the mental activity that occurs as inputs received from the senses are transformed into knowledge that the learner can use. Even through the focus is on the mental processes, the inputs received are a form of interactivity as is the transfer of knowledge to a real-world situation. Other Constructivist theories also maintain that learning is an active process in which a knowledge base in built up by relating new information and experiences to the learner's current or pre-existing knowledge base. The new information and experiences come from the learner's interaction with the learning environment.

3.4.1 Defining Interaction

The concept of 'interaction' generally means "exchange," "interplay," or "mutual influence." However, in analyzing the literature on interaction, it becomes apparent that there seems to be many ways to define interaction. One important facet of interaction is that it does not refer to a solo activity, but it involves two-way communication, which Selnow (1988) expands to specify that message must be receiver-specific, that message exchange must be response-contingent, and that the communication channel must provide two-way information flow to accommodate feedback.

Ellen Wagner (1994) proposed that interaction could be defined as follows:
"Interactions occur when these objects and events mutually influence on another. An instructional interaction is an event that takes place between a learner and the learner's environment. Its purpose is to respond to the learner in a way intended to change his or her behavior toward an educational goal. Instruction interactions have two purpose: to change learners and to move them toward achieving their goals" (Wagner, 1994).

3.4.2 Dimensions of Interaction in Learning

Interaction can be seen as occurring in various dimensions. By considering distinct dimensions one can consider the important characteristics of interaction with respect to these modes. Michael Moore (1989) considered interaction within an educational context occurring in three dimensions: Learner-Content, Learner-Instructor and Learner-Learner interaction. These distinctions have subsequently been used as building blocks and referents for frameworks for analysis and more complex model of interaction.

Moore described learner-content interaction as intellectual interaction with the content. Learner-content interactivity is now typically seen as the way that content is used and the ability to affect, change and negotiate that content. Moore's original perception of learner-content interaction might fit better within what are later described as learner-self interactions (Hirumi, 2002).

Learner-instructor interaction allows feedback between the educator and the learner. The learner is able to draw on the experience and knowledge of the instructor, and the instructor to gauge and assess individual needs. Moore, talks about the need of an instructor to help students apply new knowledge correctly, apply it as intensively and extensively as possible or desirable, and make the instructor aware of areas of application.

Learner-learner interaction can take place with or without the presence or influence of the instructor. As to the value of learner to learner interaction, Moore states that, "it depends largely on the circumstances of the learners and their age, experience, and level of learner autonomy."

Another interaction dimension by which learning theories and interactivity may be examined relates to the *context* in which learning is undertaken. Dey and Abowd (2000) have defined "context" as any information that characterizes a situation related to the interaction between users (learners and/or instructors), applications, and the surrounding environment. This remarkable infusion and mobility creates new interaction types. Peng, Chou & Chang (2007) propose a fourth type, learner-context interaction, representing the interactivity wherein a system adapts to the needs of individuals in order to fulfill those needs.

Hillman, Willis, and Gunawardena (1994) also added *interfaces* as one of context dimension. They identified the *interfaces* within technological environments as points of interaction between content, learners, and instructors. The interface is not neutral and will have effects on the way interaction within the other dimensions occurs. The importance of being able to achieve successful interaction with the interface is considered a prerequisite for successful interaction within Moore's three dimensions. The researchers claim that successful interaction is highly dependent upon how comfortable a learner feels working with the delivery medium, through which a learner can interact with content, the instructor, and other learners.

Last dimension binds all the dimensions that have mentioned above: *pedagogy*. Pedagogy refers to that set of instructional techniques and strategies which enable learning to take place and provide opportunities for the acquisition of knowledge, skills, attitudes and dispositions which a particular social and material context. It refers to the interactive process between instructor (or facilitator) and learner, and to the learning environment. This dimension is critical, as it will determine the extent to which the learner is able to move (navigate), test (explore) and maneuver (self pace) through the learning environment. Learning theories help to determine what methods, strategies, and tactics used to organize the content to affect and measure of learning.

3.4.3 Degree of Interaction in Learning

The outcome of the learning process is affected by the degree of the learner's participation in and engaging with the content material. For example, Fenrich (1997) comments that, "interactivity, or instructional features that promote active learning, provides critical support for increases in learning and retention in all educational activities… Interaction implies active learner

participation in the learning process… an essential condition for effective learning… failure to build interactivity into your program will reduce learning and retention."

Many studies treat interaction as a one-dimensional construct, but interaction is a multidimensional construct (Boak, Kirby, 1989; Haseman, Polatoglu & Ramamurthy, 2002). For example, Wagner (1999) has identified a number of specific elements that affect the interaction. Wagner's elements include participation (engaging learners actively), communication, feedback (reinforcement, correction, and direction), elaboration (providing alternative examples and explanations), learner control and self-regulation, motivation, negotiation, team building, discovery (promoting cross-fertilization among ideas), exploration (defining the scope and depth of ideas), and clarification (p.642-3).

Feedback, control, participation, motivation, and social exchange and collaboration are commonly identified in many studies supporting interaction as a multidimensional construct. These elements affect the level or degree interaction and the subsequent outcome on learning which could be different depending on the degree of impact of these six elements. The following paragraphs are short descriptions of these six elements and how each element affects the process of learning.

1) Feedback

Feedback is perceived as being a crucial component of interaction (Berge, 2002) and that without feedback there can be no interaction (Borsook & Higginbotham-Wheat, 1991). Clariana, Wagner and Murphy (2000) insist that learning "involves the interaction of new information provided by instruction with existing information already in the learner's memory." Narciss (1999) suggests the role of feedback in the learning process is not simply information processing, but a more complex milieu with feedback having an influence on the learner's affective and motivational processes. Bloom (1976) listed feedback along with cues, participation, and reinforcement as one of his four elements to determine the quality of instruction.

Feedback is often subject to classification schemes outlining inherent characteristics. Carter (1984) writes of feedback having four characteristics: function, timing, schedule, and type. Brinko (1990) suggests that understanding feedback requires addressing the who, what, when, where, why, and how of feedback method. The classic Kulhavy and Stock model (1989) describes the feedback process as consisting of three cycles:

In Cycle I, a task demand is presented and the learner receives information from the task, processes this information, and produces a response. In Cycle II, feedback is presented and is processed by the learner to yield any response corrections. Finally, in Cycle III, the original task demand is presented again as a test item, which is processed and responded to the learner to produce a posttest response (Kulhavy & Stock, 1989). Feedback is social activity, and the value of the feedback is dependent on the quality of the feedback and how learners receive and ultimately use it.

2) Control

Another critical component of interaction is control. Rhodes and Azbell (1985) distinguish three form of interactivity that integrate the control of content and structure: reactive (limited control

of structure and content), coactive (a mix of limited and extended control of structure and content) and proactive (extended control of structure and content). Reactive design comes from the behavioristic stimulus-reaction paradigm, while proactive design assigns an actively constructing role to the learner.

One important implication of this description concerns learner control: on the reactive level, the designer maintains complete control over the subject matter, its presentation, sequence, and the exercise levels. On the proactive level, rather more control passes into the hands of the user (Schwier & Misanchuk, 1993). As more control is provided to the learner the more they become proactive with greater motivation to learn.

However, too much control might be unproductive and result in disappointment performance. The structures provided by the content and/or instructor can help to guide and scaffold learner activities. There is a danger that is pushing all the control onto the learner he or she might become lost. The locus of control is represented by Borsook and Higginbotham-Wheat (1991) as a medium point where interaction is at its highest.

In reality the optimal locus of control might be dependent on many factors including the nature of the tasks, content, and subject matter, and the meta-cognitive skills and levels of development of the learners.

3) Participation

In comparison to the overt action of controlling the pace and sequence of the learning or entering into a dialogue, the extent to which a learner actually participate in and engages with the content material focuses on the outcome of the learning process.

This reflects a shift in emphasis from the overt nature of interactivity to the extent to which internal learning is facilitated. In providing a set of guidelines for interactivity, Fenrich (1997) suggests the following set of options to increase learner participation:

- Thought provoking *questions* to enable the user to mentally process information
- Active *participation* in a simulation or an educational game
- Providing *feedback*, both detailed and elaborative
- Building on *current knowledge* and *experience*, allowing learners to compare predications and solutions
- Learner *control* of pace and sequence
- Student *comments* and annotations, for later analysis and comparison
- Learner *modifications* to their own material

4) Motivation

Motivation can be seen as a product of interest in the content, supportive and enjoyable social settings and personal engagement in meaningful tasks with clear relevant information. Malone (1984) has identified three important characteristics of learner motivation: challenge, fantasy and curiosity. Challenge includes providing goals whose attainment is uncertain but which are not so lofty that failure is predominant. Fantasy is defined as evoking mental images of things not presented to the senses or within the actual experience of the person involved and may include

images of objects, situations or events. Curiosity, while similar to challenges, does not involve self-esteem. Motivation is a goal-directed behavior instigated and sustained by expectations concerning the anticipated outcome of actions and self-efficacy for performing these actions.

Martin and Briggs (1986) reported that motivation is a hypothetical construct that broadly refers to those internal and external conditions that influence the arousal, direction and maintenance of behavior. It is an umbrella term that encompasses a myriad of terms and concepts such as interest, curiosity, attribution, level of aspiration, locus of control etc.

Keller (1993) proposed a similar model for motivation. He observed that our understanding of how to arouse and maintain student interest in learning is far behind our knowledge of how to facilitate learning once the student has the desire to achieve. He proposed that interest, relevance, expectancy and satisfaction must be attended to in the learner. Interest refers to whether learner's curiosity is aroused and whether this arousal is sustained appropriately overtime. Relevance refers to a learner's perception of personal need satisfaction in relation to the instruction or whether a highly desired goal is perceived to be related to the instructional activity. Expectancy describes as the perceived likelihood of success, and the extent to which success is under learner's control. Satisfaction refers to the combination of extrinsic rewards and intrinsic motivation, and whether these are compatible with learner's anticipations. The following are the essential strategic components of the model for motivating instruction:

- Attention strategies for arousing and sustaining curiosity and integrity (perceptual arousal, inquiry arousal and variability)
- Relevance strategies that link to learners' needs, interests, and motives (goal orientation, motive matching and familiarity)
- Confidence strategies that help learner develop positive expectation for successful achievement (learning requirement, success opportunities and personal responsibilities)
- Satisfaction strategies that provide extrinsic and intrinsic reinforcement for effort (intrinsic reinforcement, extrinsic reward and equity)

5) Social exchange and Collaboration

Most theorists of learning as well as prescriptive guides for learning enhancement suggest the need for active learning to increase effectiveness (Bates, 1995; Smith, 1996). In describing active learning two contexts for interactions have been identified: individual and social (Bates, 1995). Bates states that, "there are two rather different contexts for interaction: the first is an individual isolated activity, which is the interaction of the learner with the learning material, be it text, television; the second is a social activity, which is the interaction between two or more people about the learning material. Both kinds of interaction are important in learning" (Bates, 1995).

Social interaction among peers is important to learning (Bonk & Cummings, 1998; Morgan & O'Reilly, 1999). It allows learners to establish a personal connection to other students and to the instructor. Cazden's summary of the cognitive benefits of peer interaction includes four major points:

- Students are forced to confront each other's ideas
- Students can enact complementary roles, provide mutual guidance and support, and can serve as scaffolding to help each other accomplish learning tasks that might otherwise be too difficult
- Students can find a direct relationship with a real audience from which they can get meaningful feedback
- Students can experiment and construct new understandings and ideas in peer discourse setting (as cited Ruberg, Moore, & Taylor, 1996, p.245)

Roblyer and Wiencke (2003) highlighted the importance of student engagement and learning structured around collaborative experiences. Engagement and collaboration are characteristic of constructivist view of learning that offers 'authentic tasks, engages learners in meaningful, problem-based thinking, and requires negotiation of meaning and reflection on what has been learned' (Jonassen et al., 1995, p.21).

Collaborative learning is aimed at enhancing critical thinking skills. According to Berge (1998) improving critical thinking skills, reasoning, and problem solving skills is best achieved by highly structured and collaborative activities. As collaborative skills are improved the student has increased self-esteem and higher level of achievement.

3.5 Dimensions in Learning Environment

Wagner's definition of interaction have used as a starting point from which to consider the role of interaction computer-mediated learning environments. Also, interaction have seen as occurring in various modes that help the view of interaction as a social construction which parallels to the definition of a learning environment where learners may work together and support each other as they use a variety of tools and information resources in their pursuit of learning goals and problem-solving activities.

What is important to understand is that the learner's level and type of activity and interaction affects learning. For best results, learning materials should provide feedback to the learners, and allow certain degree of control to the learners. The level of challenge, fantasy and curiosity of learning content will affect the motivation for the learners. Social structures in the learning environment also contribute to effective learning by collaboration which high level of social present encourages deep and meaningful learning. These elements affect the level or degree interaction and the subsequent outcome on learning which could be different, depending on the degree of impact of these six elements.

In summary, we can identify the interaction dimensions in learning environment as: learners and instructors/facilitator as the who (participants) of the learning process; content as the what of the learning process; context as the when and where of the learning process; and pedagogy as the how of the learning process (Figure 3.1).

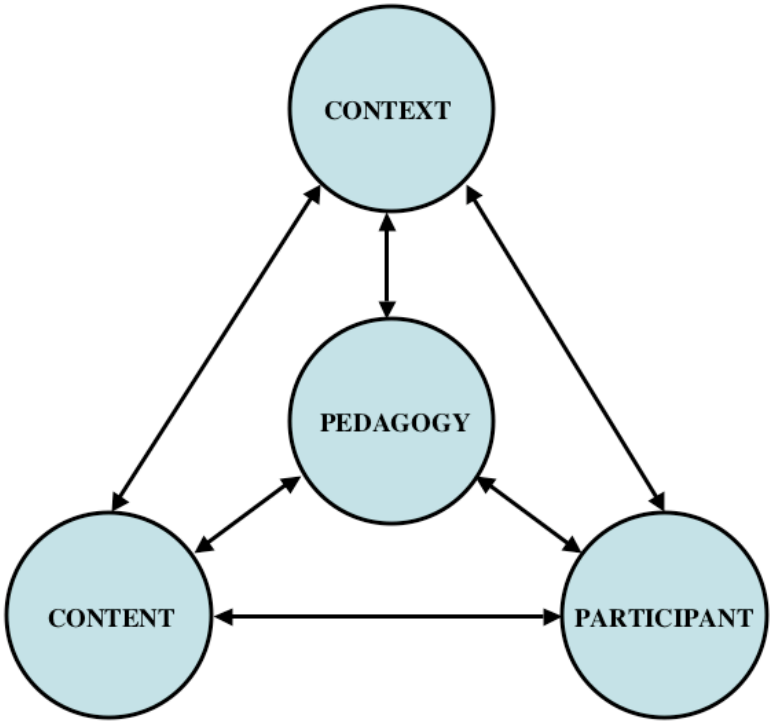

Figure 3.1 Dimensions in Learning Environment

The components of this model include:

- ***Context*** – the when and where of the learning process. Consists of the environment, circumstance, and events that impact a learning activity, program, or task.
- ***Content*** – the what of the learning process. The information that is contained in a resource and that is intended to affect a change in cognitive state; subject matter.
- ***Participant*** – the who of the learning process: 1) Facilitator/Instructor is a person who facilitates and bridges between the learners and the learning source (Content), 2) Learner is an individual involved in the acquisition of knowledge or skills and an active participant in the experience
- ***Pedagogy*** – the how of the learning process. Learning theories help to determine what methods, strategies, and tactics used to organize the content to affect and measure of learning.

The following chapter will discuss the understanding of how learners interact with and use unique capabilities of different medium's format which is essential to understanding the effect of media on learning and construction of digital learning environments.

Chapter 4 Virtual Environment (VE) and Game

4.1 Learning Media

As discussed in Chapter 2, we understand that learning is not simply a passive response to instruction's *delivery*. Rather learning is an active, constructive, cognitive, and social process by which the learner strategically manages available cognitive, physical, and social resources to create new knowledge by interacting with information in the environment and integrating it with information stored in memory. From this perspective, knowledge and learning are result of a reciprocal interaction between the learner's cognitive resources and aspects of the external environment.

In this context, learning media is a complementary process within which representations are constructed and procedures performed, sometimes by the learners and sometimes by the medium. Media embody certain characteristics that "interact with learner and task characteristics to influence the structure, formation and modification of mental models" (Kozma, 1991). Within this framework, particular media formats (e.g., prints, video medium) possess particular characteristics that make them both more and less suitable for the accomplishment of certain kinds of learning tasks.

Saloman (1979) argued that media could be analyzed in terms of their "cognitively relevant" capabilities – i.e., in terms of those characteristics that affect the ways in which individual's represent and process information. These capabilities relate to three aspects of each medium: its technology, symbol system(s), and processing capabilities. "Technology" refers to the physical, mechanical, or electronic capabilities that determine a medium's function. "Symbol systems" are sets of symbolic expressions by which information is communicated according to specific rules and conventions: spoken language, printed text, pictures, and numbers all exemplify symbol systems. "Processing capabilities" refer to a medium's abilities to operate on symbol systems in specified ways – for example, by displaying, receiving, storing, retrieving, organizing, transforming or evaluating whatever information is available through a particular symbol system (Saloman, 1979).

Each medium can be defined and distinguished from others by a profile of these three kinds of capabilities. Using this profile, a particular medium can be described in terms of how it presents certain representations and performs certain operations in interaction with learners, who are simultaneously constructing and operating on mental representations.

4.1.1 Print and Video Media

The stability of the print medium (books, magazines, journals) has important implications for how learners process information from books and magazines; it aids in constructing meaning from the text. In general, reading progresses in a forward direction and at a regular rate as the reader moves along, readily constructing a mental representation that relates the information in the text to an existing mental model[1]. However on occasion, reading processes interact with prior

[1] A mental model is an internal representation that people form and use while interacting with the environment (problem, system, etc.). To a certain degree, this representation contains structural

knowledge and skill in a way that relies heavily on the stability of the text to aid comprehension and learning. While poor readers are often thwarted by the effort required to decode the text, fluent readers use the stability of the text to avoid reading failure. Encountering longer or novel words, these readers will slow their reading rates, go back to review a word as an aid to recalling a meaning for it, or review a phrase or sentence to determine the meaning of the word from context (Just & Carpenter, 1987). Even readers with highly developed reading skills and elaborate memory structure rely on the stable structure of print to process large amounts of text in familiar domains. Most readers use the stability (technology) of the printed text to process (read) its content (symbol system) and thereby construct or elaborate on a mental model.

What happens when pictures or diagrams are introduced into this medium? What is the cognitive effect of these symbol systems in combination with text? How does the stability of these symbols, as presented in books, interact with processing? A large body of traditional research suggests that using pictures in combination with text generally increases recall, particularly for poor readers if the pictures illustrated information central to the text, when they represent new content that is important to the overall message, or when they depict structural relationship mentioned in the text (Levie, W. & Lentz, R., 1982).

Several studies indicate that readers use pictures to create or to evoke the preliminary mental model that guides subsequent reading and assists in the construction of more elaborate and interrelated models (Stone & Glock, 1981). Other studies suggest that the use and effectiveness of pictures are related to prior knowledge: more knowledgeable readers tend to build mental models from existing knowledge and to elaborate them using information from the text, while less knowledgeable readers tend to relay more heavily on pictures or diagrams to construct mental representations of new information (Hegarty & Just, 1989). Younger children, who many not have sufficient prior knowledge from which to generate elaborate mental models, may benefit most from pictures to aid this process (Pressley, 1977). The stability of the medium allows the kinds of serial, sequential, back-and-forth processing between specific information in the text and components of the pictures that facilitates the construction and elaboration of mental models.

Television-or any video medium-differs from books (or other print medium) in several ways that may affect cognitive structure and processes. First, these media can combine visual and audio stimuli and present them simultaneously. Several studies have examined the effect of presenting stories with combined audio (verbal narration) and visual (moving images) information versus separate presentation (either audio or visual) on children's and adult's memory for the information presented (Beagles-Roos & Gat, 1983; Calvert, Huston, Waltkins & Wright, 1982; Hayes, Kelly, & Mandel, 1986; Newman, 1989). The results of these studies show that the combined use of audio and visual information enhances the subject's memory performance compared to the presentation of either source alone.

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information about the properties of the system and functional knowledge about the task to perform. On the other hand, mental models are incomplete, unstable, and unscientific, but they can be used for planning, execution, evaluation, and interpretation of the system or problem the subject has to solve. Mental models are naturally evolving model and are changed and, most of the time, refined as additional information is required (van der Veer & del Carmen Puerta Melguizo, 2003).

Second, the technology of these media makes both their verbal and visual symbol systems transient rather than stable. Linguistic information can be orthographic (as in captioned films); but more often it is oral and, like the images on the screen, disappears quickly. Information is presented continuously at a given time and pace that is not under the control of the user, and once presented, it is not retrievable other than memory.

Program pace has been defined as the amount of information presented per unit of time. Very little research has addressed the effect of pace on comprehension, but this aspect of video presentation clearly distinguishes them from print and may interact with learning in significant ways. With books, the reader sets his or her own cognitive pace (i.e., words or visual elements per unit of time) to accommodate personal requirements for comprehension. With video, the pace is set by someone other than the learner, and the presentation (i.e., words or visual elements per unit of time) progresses without regard to individuals' cognitive requirements. Without the opportunity for reflective thought, video is forced to portray internal thought through external action. This lack of a reflective model may be one reason why heavy television viewing seems to cause an impulsive style of thought and behavior.

In view of the lack of empirical work in this area, Kozma (1991) has suggested that comprehension and learning will be dependent on whether the cognitive pace of the learner can keep up with the program pace. Cognitive pace is defined as amount of information processed per unit of time. Information, in cognitive psychology, is quantified in terms of chunks, whose size depends on the familiarity and meaningfulness of the information. The pace of a presentation on television is usually not sensitive to the cognitive pace of the viewer: it progresses whether or not comprehension has been achieved. Viewers who are familiar with the information presented may be able to keep up with the program pace, even if it is fast. Moreover, if some information is missed, knowledge about a familiar domain may be used to fill in missing information from long-term memory. By contrast, if the viewer has little background knowledge, his or her chunks will be smaller and the cognitive pace will be slower, perhaps dropping below the pace at which information is presented. Since there is also less information in long-term memory that could be used to fill in missing information, this situation could quickly lead to comprehension failure.

In summary, several aspects of video media seem to have particular effects on learner's cognitive mechanisms: the simultaneous presentation of auditory and visual information, the processing pace required by transient presentation of information, and the ways in which dynamic qualities might affect a learner's mental modes.

4.1.2 Virtual Environment (VE)

The world is a rich stream of changing visual, auditory, tactile, and olfactory sensations. The form of Virtual Environment (VE) simulations reflects an ongoing evolution in the symbolic codes that are used to represent media experiences. More specifically, there has been a shift from the auditory spoken and written codes of the radio, and prints to the audiovisual codes of video medium. Although in VE, auditory dimensions are not that different from video medium, but what is unique about is that it allows user a first-person interaction with 3-D visual images in immersive environments.

VE provides another means of simulating real world place and activities. A VE is a computer-generated simulated space with which an individual interacts (Witmer et al. 1996). According to Furness (2001), a virtual world or virtual environment is synonymous with virtual reality (VR) and is defined as the representation of a computer model or database in the form or a system of virtual images which creates an interactive 3D environment which can be experienced and/or manipulated by the user.

Further definition and expansion of the term is provided by Singhal and Zyda (1999): A Networked Virtual Environment (Net-VE) is a software system in which multiple users interact with each other in real-time, even though those users may be located around the world. These environments aim to provide users with a sense of realism by incorporating realistic-looking 3D graphics and even stereo sound, to create an immersive experience. According to Singhal and Zyda (1999), a Net-VE is distinguished by the following five features:

- A shared sense of space (illusion of being located in the same place)
- A shared sense of presence (avatars of participants)
- A shared sense of time (real-time interaction possible)
- A way to communicate (various interaction methods)
- A way to share (dynamic environment that can be interacted with)

Embodiment, interactivity, perceptually salient production features, and immersion combine to make some VE simulations seem realistic. Embodiment involves the sensation that you are the character. In VE simulations, a player looks out the eye of character, and the world looks similar to how it looks when a person looks out their own body. This experience makes the player to suspend reality and to feel like they are physically in a computer-generated environment (Barfield, Zeltzer, Sheridan, & Slater, 1995).

As a distinct type of multimedia, VE shares the technology and symbol systems of interactive video environments but embodies processing capabilities that suggest an important difference for learning. The nonlinearity of VE suggests the capability of this technology to allow learners to create associational links within and across, text, images, and other symbol systems to facilitate cognitive flexibility. It allows learners to explore in multiple ways using a number of different concepts and themes. This exploration should result in the development of integrated, flexible knowledge structures interconnected by crisscrossing conceptual themes that facilitate the use of this knowledge to solve a wide range of problems. Each concept can subsequently be used in many different ways, and the same concept can apply to a variety of situations.

VE allows learners to add their own information and construct their own relationships. As Salomon (1979) points out, such systems can reflect the processes learners use when constructing interrelationships in their own mental models and thus encourage them to think not only about ideas but also about how they are interrelated and structured. More importantly, such systems can provide explicit models of information representation that learners can use guideline for constructing their own internal models.

Some of characteristics from Virtual Environment that stand out from other media are:

- VE enables first person experiences, which are natural, unreflected and personal, generating direct, subjective and personal knowledge.
- VE can stimulate high levels of involvement and give multiple perspective sensorial experiences: Dede, Salzman, & Loftin (1996) claim that the user of VEs provides multi-sensorial experiences for better understanding abstract concepts. Multi-sensorial interactive experiences involve the learner and stimulates understanding and learning.
- Facilitate usability and enhance high interaction: for the navigation and manipulation of synthetic environments
- VE can provide the possibility to experience something that is impossible or dangerous in the physical world

4.2 Virtual Environment (VE) is not a Game

Limber (1998) claims that with the advent of VE, the creation of experiences that completely immerse the senses of the participant is one of the major goals. Sight, sound, and touch can be manipulated synthetically to produce a seemingly transcendental effect. VE promises to change the way everything from science to art is expressed and perceived. However, the open question for this new medium is the same as for all forms of expression – what and how content should it express? The system itself is void without meaningful content.

VE is not a computer game. It is only a "platform". VE does not have an inherent in-world game narrative[2] naturally, but is instead simply a simulated world. For example, Second Life[3], a multi-user advanced, visually enhanced, interactive online environment is currently inhabited by over one million residents from around world. However, Second Life is not a game[4]. Users login and assume control of digital puppet (avatars), and interact with one another. Users have control over their environments, and can purchase items such as clothing for their avatars. But there the gaming comparisons end. It is a virtual world without theme, a virtual canvas for creativity, not inherently based in mock war such as video games. There are no levels to attain, no opponents to beat, or no pre-defined goals.

Most of learners, especially in the early stages learners, need tasks that are carefully structured and paced. Over time, they should take increasing responsibility for their own learning activities[5] and a well-designed task will allow learners to approach the activity in different ways, while working towards the same outcomes. Also research indicates that providing some structure within the learning environment is more effective than pure exploration for achieving certain

[2] In digital games, a narrative is an account of something that happens to someone (Barrett, 1997). It consists of series of events, from the background setting to the completion of the game. Discussed in more detail in chapter 5.

[3] www.secondlife.com

[4] By Dempsey et al, (1996, p.2) define a game as, "… a set of activities involving one or more players. It has goals, constraints, payoffs and consequences. A game is rule-guided and artificial in some respects. Finally a game involves some aspect of competition, even if that competition is with oneself."

[5] Learning activities can be defined as 'specific interaction of learners with other people, using specific tools and resources, oriented towards specific outcomes.

types of learning outcomes (Mayer, 2004). Because it is only a *platform,* VE can be ambiguous for learners with lock of frames (in terms of tasks or activities) and framing (in terms of how it 'fits' into the curriculum) and it would be difficult to deliver the learning content by itself. Therefore, VE needs the designed learning activities that can ensure the learning outcomes and game structure could help to design the learning activities in VE.

4.3 Delivering the Content: Game

4.3.1 Concept of Play

Games and game-like activities have a long tradition within the theory and practice of pedagogy[6]. A game of Hangman (where children fill in the missing letters of a word), for example, serves the larger goal of teaching learners how to spell complicated words, but to the learner, it may just be a game. Even as the years pass, we can still remember the games that our teachers allowed us to play, games that may have seemed "just for fun" but had a deeper purpose.

On the face of it, play may not seem to need definition, explanation, or study; most of us would say we recognize play when we see it. Play is often construed by adults, as the opposite of work. Let's look at a child at play with Lego blocks. To the outsider, the player is likely to look somewhat scattered: the child will be working fiercely one moment constructing a building or acting out a story, and then just as a abruptly the child will shift gears, knocking down what he/she's built. Whether the child has been exploring the physical nature of things or obliterating everything he/she's just accomplished, the child at play is exercising freedom along four distinct axes: freedom to fail; freedom to experiment; freedom of effort; and freedom of interpretation.

- ***Freedom to Fail***: One doesn't actually fail at play per se, but one is free to do things at play that would look like failure in other contexts. Think of the block tower that inevitably collapses, or the sand castle fated to disappear with the tide. At play the child has unlimited freedom to undertake such doomed enterprises, and learns as much about the nature of things from failure as from success. Children at play do not have adults looming over them, fretting about the cost of these failures, and so children are free to learn from failure and move ever closer to mastery of their world.
- ***Freedom to Experiment***: This correlates closely with the freedom to fail, but suggests in addition that within the play space the player has some room to maneuver and invent new approaches to whatever task is at hand. It is not sufficient that the child can build towers with blocks, but in fact she can engage in a wide array of activities with those blocks, experimenting with uses she has invented for herself. Experimenting would be meaningless without the ability to fail regularly, and the freedom to fail would amount to little if players were constrained in where they could see that failure.
- ***Freedom of Constraint***: The absence of negative consequences allows the exploration of situations that would otherwise be considered risky.
- ***Freedom of Interpretation***: Learning about games and learning with games take place simultaneously. One cannot learn about or from games without engaging in

[6] Techniques, strategies and methodology applied to facilitate student learning.

their play, yet we must always remember that there is no "one" game; the individual, social, and cultural motivations of any player affect what is experienced through play and no two players ever experience the "same" game. This creates a challenge for those looking to games to provide a standardized context for learning.

4.3.2 Games

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

At first blush, games, with their rules, constraints, and externally defined goals seem to be at odds with the freedoms of play. But within the proscribed space of a game, players regularly exhibit all of the freedoms of unstructured play. Most players undertake games in the knowledge that failure is a possibility. They show a willingness to experiment in their game-play, and to try on different roles from leader to follower, novice to expert (Gee, 2003; Squire & Steinkeuler, 2005).

By offering challenges that seem worth attempting, games channel layers' efforts, while still affording them the freedom needed to manage their individual experience in ways that are self-directed and beneficial to their own development. In games, children submit to arbitrary rules and structures, but only if they can continue to be playful. Experience plays a big part in understanding what makes a game fun and one of the motivations to stay in games.

Games are effective not because of what they are, but because of what they embody. One could argue that play is the dominant feature of games (e.g., Pearce, 2004). Researchers like Papert (1998) and Gee (2004) point out that play is primarily a socialization and a learning mechanism common to all human cultures and many animal species. Play theory says that play is the most effective instructional technique regardless of domain. This conclusion is based largely on the observation that we learn more in the first years of life than we do in any other corresponding time in our lives (Lepper & Chabay, 1985). "Games are thus the most ancient and time-honored vehicle for education" (Crawford, 1982). Rieber (1996) says research in "anthropology, psychology, and education indicates that play is an important mediator for learning and socialization throughout life" (p. 44) and that "Having children play games to learn is simply asking them to do what comes naturally… However, playing a game successfully can require extensive critical thinking and problem-solving skills" (p.52).

Games have been as subsets of both play and fun (Prensky, 2001). A game is recognized as organized play that gives us enjoyment and pleasure (Prensky, 2001). Dempsey *et al*. (1996, p. 2) define a game as, "*…a set of activities involving one or more players. It has goals, constraints, payoffs and consequences. A game is rule-guided and artificial in some respects. Finally, a game involves some aspect of competition, even if that competition is with oneself."*

There are different opinions about what the game characteristics are. For example, Johnston et al. (1993) suggested that the rules, goal and interaction are the essential features. Baranauskas et al. (1999) stated that the essence of playing is challenge and risk. According to Malone (1981), four elements of simulation games can be defined: fantasy, curiosity, challenge, and control:

- *Fantasy* stands for the scenario and the 'virtual' world in which the activity is embedded. If games involve imaginary worlds, activity inside this world has no impact on the real world, and nothing outside the game is relevant.
- *Curiosity* is sustained by the continual introduction of new information and nondeterministic outcomes.
- *Challenge* is provided within each appropriate level of difficulty. Game developers design challenge by the participant's activities, using progressive difficulty levels (e.g., accelerating tempo or switching to the expert option in Chess) and providing multiple goals meaningful for different individuals. When the level of difficulty is too low, players lose interest. The same occurs if the challenge is too difficult relative to the players' abilities.
- Through opportunities to make choices that have direct consequences, players *Control* the game development. Players can control a character within a game that has to solve different tasks and is confronted with problems. However, the players or learners have to be the ones making the decisions and choices.

4.3.3 Non-linearity

Non-linearity gives interactivity meaning to the game. In playing chess, there are multiple ways to capture the opponent's king, to move from the game's predetermined starting state to its conclusion. Indeed, there are a vast number of different ways to be victorious in chess, and that variety is what keeps the game interesting: the meaningful choices for the players to make and the outcomes of every game are not completely predetermined. Non-linearity means to the freedom of choice attributed to the players, who might take any number of paths through the game. There are a number of ways to achieve it: in terms of the game's story, in terms of how the player solves the game's challenges, in terms of the order in which the player tackles the challenges, and in which challenges the player chooses to engage. All of these components can contribute to making a game non-linear, and the more non-linearity the developer creates, the more each player's unique experience can be. Additionally, the different non-linear components can interact with each other to make the whole far greater than the sum of its parts.

- Narrative: Non-linear narrative is perhaps one of the most challenged parts of games in terms of non-linearity, with many game developers allowing for non-linear gameplay[7] while constraining their games to a completely linear story. Discussion on non-linear narrative in digital game in chapter 5.
- Multiple Solutions: Not every player will think of the same way to go about solving a situation, and, given that these alternate solutions are reasonable, any challenge must have multiple ways for the player to overcome it. Having multiple solutions to the individual challenges within a game is a big part of non-linearity; it enables the player to

[7] Gameplay is the experience of a formal system, constituted by rules that constraint player agency towards interesting challenges, with intention of achieving specific goals. Discussed in more detail in chapter 5.

have multiple paths to get from point A (being presented with the challenge) to point B (solving the challenge).

- Order: Beyond being able to figure out the solutions to challenging in unique ways, players enjoy the ability to pick the order in which they perform challenges. Many adventure games have made the mistake of being overly linear by allowing the player access to only one puzzle at a given time. In order to even attempt a second puzzle, players must complete the first one. That is a linear way of thinking, which proves especially frustrating when a player gets stuck on a particular puzzle and, due to the game's linear nature, can do nothing else until that puzzle is solved. Giving the player choices of different puzzles to solve allows them to put aside a troubling puzzle and go work on another one for a while. After completing the second puzzle, the player may return to the first, refreshed and revitalized, and thereby have a better chance of solving it.
- Selection: This allows the player to pick and choose which challenges they want to overcome. Say that between point A and point B in a game there lies a series of three challenges, X, Y, and Z, which are non-order dependent, that is, the player can do these challenges in any order he wishes. What if, once the player surmounts challenge X, he does not have to go back and solve challenge Y or Z, he can simply move on to point B in the game, perhaps never returning to Y or Z? The same is true if the player initially chooses to tackle Y or Z instead of X. Any one of the choices will allow the player to proceed. The advantage is that if the player finds challenge X to be insurmountable, he can try challenge Y or Z. This greatly decreases the chance of the player becoming permanently stuck. It need not be the case that Y is easier than X; the mere fact that it is different may allow the player a better chance of getting through it, depending on his strengths as a player. Other player may find X to be easier than Y or Z, but giving the player a choice of which challenges he takes on allows the player to exploit his own personal skills to get through the game. Of course, after completing challenge X, the player may still have the option of going back and completing the Y and Z challenges, perhaps just for the fun of it or because overcoming those challenges somehow improves his chances down the line. Perhaps completing Y and Z gives his player character greater overall experience or riches.

Non-linearity is included in the game because it provides the player some meaningful authorship in the way he or she plays the game. If forced to stay on a specific line to get from the beginning of the game to end, the player will tend to feel trapped and constrained. The challenges along that line may be brilliantly conceived, but if the player has no choice but to take them on in order, one by one, the fun they provide will be greatly decreased.

Non-linearity is great for providing players with a reason to replay the game. Replaying a game where the player has already overcome all of the challenges is not that much fun. In replaying a more non-linear game, however, players will be able to steer away from the challenges they succeeded at the last time they played and instead take on the game's other branches.

One important note is that non-linearity is not about having the player wander around the game-world aimlessly, especially in digital game. If the game is non-linear to the point where the

player has no idea what he or she is supposed to try to accomplish or how he or she might go about it, the non-linearity may have gone too far.

4.3.4 Summary

When using games in general for educational purposes, several aspects of the learning process are supported. First, learners are encouraged to combine knowledge from different areas to choose a solution or to make a decision at a certain point. Also, learners can test how the outcome of the game changes based on their decisions and actions. Additionally, learners are encouraged to contact other team members, to discuss, and to negotiate subsequent steps, thus improving, among other things, their social skills.

Games can be a strong motivating and engaging factor to learners. When learners are engaged in the learning process, they learn and retain more. Engagement can come though emotion, relaxation, and especially through fun (Mitchell & Savill-Smith, 2004). Researches indicate that digital games flexible and complex enough to provide for different learning styles and encourage collaboration (Sedighian, 1994; Kirriemuir, 2002). Furthermore, Digital game environments present an immersive, non-linear environment, and active performance-based setting. By accommodating different learning styles games can allow learners in different emotional situations and stimuli which lead students to learn by doing and experiencing (Dondi & Moretti, 2005).

In summary, some of the game elements could be attractive to leaner because:

- Game provides some degree for fun.
- Game has an obvious and significant goal that can be potentially matched with learning goal.
- Game has an interactive mode.
- Game provides the gaming feedback and the related result.
- Game has winning rewards to motivate the learner.
- Game has conflict, competition, challenge, and opposition factors that can sustain learner's attention.

In addition Bramucci (2002) stated the basic learning behavior and learning mode with gameplay environment. Keri Facer (2006) claimed that a game could be continuous activity or a simulation in real life. Games have some characters, for instance, the enjoyment and the independence. All of these characters were quite different from traditional instructional activities. For this reason, to utilize the interaction provided in game have a potential strengthen for the learning motivation and problem solving ability of the learner.

Chapter 5 Digital Game as a New Learning Environment

5.1 Virtual Environment + Game → New Learning Environment

5.1.1 Digital Games

Digital game or electronic game is defined as "a software program in which one or more players make decisions through the control of game objects and resources, in pursuit of a goal." (Overmars, 2007) In digital games, game software takes advantage of multimedia technologies and other computing technologies such as networking to enable its user (or game player) to experience goal-directed play in a rich virtual environment.

Looking at the tremendous role and motivational power (Bowman, 1982; Gage & Berliner, 1988) of digital games (computer games, online games, and video games) in youth culture today, it may be a promising idea to use learning and teaching principles of this comparatively new form of gaming to enhance the ways of learning in school, university and so on. For instance, the importance of gaming for education might best be summarized by the rhetorical question an elementary school student raised at the Game Developer's Conference: "Why read about ancient Rome when I can build it?" (Moulder, 2004) Though most digital games are not designed to be educational, yet they are immersive, experiential learning environments. Ignoring the educational power of games dismisses a potentially valuable learning tool.

Whether we view digital games as problematic or beneficial, we cannot ignore the compelling methodologies and complex dilemmas and practices that these spaces use to engage children and adults for hours on end. Whereas traditional learning environments frequently describe the how and what, and then leave it to the learner to reflect on the ways in which content relates to personal situations (the why), a well-designed digital game provides a rich narrative that establishes the why, while the how and the what are developed through playing the game, as opposed to description about the world.

In the course of the brief history of digital games, a number of different game genres have developed. Table 5.1 shows an overview of the seven best known digital game genres.

Game Genres	Summary
Action Games	Action games often involve steering a character whose intention is to carry out an assignment and overcome obstacles. The assignment may be to wipe out an enemy with the help of various types of weapon. The pace is often rapid combined with dramatic sounds. This is perhaps the most basic genre, since the activity involved is principally reactive, and their relative simplicity (both in terms of their use and their creation) also means that this is perhaps the most broadly used type of game. *Examples: Half-Life, Doom, Spacewar*
Adventure Games	Adventure games place the main emphasis on the story, and the pace is often slower than in action games. These games involve exploration of, and interaction with, the environment and elements and characters within it as the main activity. The player is usually required to solve puzzles in order to find different items, work out the next step involved, or understanding the environment. The interactions are usually more centered on the use of different tools rather than simply shooting. *Examples: Legend of Zelda, Tomb Raider, Mario*
Role-Playing Games (RPG)	The activity involved in role playing games derives from the assumption by the player of a particular role which has a series of characteristics, skills and abilities, which the player may define at the start of the game. Activity within the game often involves a series of quests or tasks to be performed often involving rescue and the objective tends to be increase the power, skills and abilities and experience of the role character by successful performance, in this way developing the character. *Examples: Legend of Zelda, Shenmue, Ocarina of Time*
Strategy Games	In strategy games, the emphasis is on the use of tactics and strategy to solve challenges or defeat enemies. They may for example involving building up a civilization or leading an army into battle against another. The goal largely concerns attaining strength and power. Strategy games also contain elements of simulation, role-playing, sport and action. *Examples: Civilization, Command and Conquer*
Simulation Games	Simulation games aim to realistically mimic the conditions of a particular environment or activity. There are various types of simulation and in some senses they repeat the patterns involved in the other games genres with the difference that the aim is a focus on the imitation or reproduction of real conditions, while games tend to involve invented or fantasy worlds. *Examples: Flight Simulator, SimEarth*
Puzzle Games	This types of games mainly involve solving of a puzzle of some kind. Some times it against the clock, or requires physical skills as well, which takes them close to the action genre. These games do not usually have a story element. *Examples: Tetris*
Card & board Games	This genre simulates the familiar and classic card and board games. One can play against the PC or against another player online or on the same PC. *Examples: Solitaire, Poker, Bridge*

Table 5.1 Overview of various game genres

5.1.2 Digital Games for learning

One cannot be passive in a game or simulation. Learners engaged in games and simulations are interpreting, analyzing, discovering, evaluating, acting, and problem solving. This approach to learning is much more consistent with active learning, where knowledge is constructed by the learners as they are actively problem solving in an authentic context, than with traditional instruction.

Digital Games also offer advantages in terms of motivation. Oftentimes learners are motivated to learn material (e.g., mythology or math) when it is required for successful gameplays[1]–that same material might otherwise be considered tedious: "Digital Games inspire players to seek out data and information in order to be successful, rather than starting with facts and figures and then figuring out how they may be relevant" (Rickard & Oblinger, 2004).

A sense of competition and one's status in the gameplaying community encourages students to work hard. It is more apparent in the multi-user digital game environments. The recognition and respect that comes from successful gameplay, "fuels participation and invests the player in the experience because it transforms knowledge into social capital. Not only do players 'own' their learning (because they participated in the construction), but also ownership is worth something in a social context where one's status derives from peer acknowledgement (an incentive that is often more powerful than grade point average or teacher approval)." (Rickard & Oblinger, 2004)

Digital Games engage. They are seductive, deploying rich visual and spatial aesthetics that draw players into fantasy worlds that seem very real on their own terms, exciting awe and pleasure (Poole, 2000). They motivate via fun[2], via challenge and via instant, visual feedback within a complete, interactive virtual playing environment, whereby the ambience creates an immersive experience, sustaining interest in the game. They are fast and responsive, and can be played against real people anywhere in the world, or against a computer. Digital Games can handle huge amounts of content and can be instantly updated and customized by individual players (Prensky, 2001).

Another important element of digital games is the community that develops around them, especially with the multiplayer online games. Communities of players share ideas, and group problem-definition and problem-solving – not to mention a good deal of socializing – take place. In fact, the description of a digital game community mirrors the definition of an educational community of practice. The community has a culture of learning; everyone is involved in a collective effort of understanding. Group members bring diverse expertise to the community, and individual members are valued fro their contributions and helped to develop further as the group continually advances its collective knowledge and skills in the games.

Additionally, this educational community of practice offers the “apprenticeship into doing.” More experienced of ‘expert’ players are often seem mentoring or tutoring less experienced ‘apprentice’ players, lending them objects or skills, showing them around environments, and

[1] Gameplay is the experience of a formal system, constituted by rules that constraint player agency towards interesting challenges, with intention of achieving specific goals. Discussed in more detail later in this chapter.

[2] ‘Part of the natural learning process in human development’, Bisson & Luckner, 1996, p. 112

generally introducing them into what they have to do, how they should behave, and what discourse standards they should employ.

Imaginative, well-produced simulation games encourage visualization, experimentation, and creativity in finding new ways to tackle the game (Gee, 2003). The combinations of video, audio and text are useful in accommodating different learning styles, thereby promoting confidence (Berson, 1996) and encouraging multi-modal literacy. Digital games enable engagement in activities otherwise too costly to resource or too dangerous, difficult or impractical to implement in the classroom (Berson, 1996), as well as those that are hard to accomplish by other means (Thomas *et al*., 1997).

Digital Games embody well-established principles and models of learning. For example, digital games are effective partly because the learning takes the place within a meaningful (to the game) context; what you must learn is directly related to the environment in which you learn it, and is thus not only relevant but applied and practiced within that context. Learning that occurs in meaningful and relevant contexts is more effective than learning that occurs outside of those contexts, as is the case with most formal instruction (Situated Constructivist Learning Theory). Digital games are a spatial medium, allowing learners to explore the physical properties of place perhaps more readily than with traditional narratives (Squire & Jenkins, 2002).

Here are some characteristics of games that are parallel to learning (Table 5.2).

Principle	Applied to Learning	Applied to Digital Games
Active	Learners should be mentally involved in learning activities, generating connections between what they already know and what they are being asked to learn and constructing meaning from their experiences.	Digital Games provide an active environment that leads to discovery.
Motivation	The act of being motivated is to want to find out certain things, to have a desire for knowledge, to like learning and to keep on learning even if its relevance is not immediately clear.	Digital Games engage users for hours in pursuit of a goal, plus games are fun.
Community	Learning should be in such a way that supports the social and cultural realms of group interaction, peer and mentor relations, group culture, and the environmental influences of tools, settings, and techniques.	Digital Games can be played with other (e.g., multiplayer games) or involve communities of user interested in the same game.
Situated Context	Learning must be situated in rich context, reflective of the world.	Context is important in digital games. Knowing what information or techniques to apply in which situations enables greater success.
Transfer	Learning develops the ability to transfer knowledge from one situation to another.	Games allow users to transfer information from an existing context to a novel one.

Table 5.2 Learning principles and Digital Game Characteristics

Experience is also important part of learning. An ideal learning environment, according to Chris Dede (2005), allows us to alternate between being 'inside' an environment (fostering situated learning) and being an outsider looking in (fostering insights gained from perspective). Active learning based on immersive experience (real and simulated) that includes frequent opportunities for reflection is both engaging and effective for a broad spectrum of students.

Virtual environments create a sense of sensory and physical immersion resulting in one's feeling "inside" an environment. These immersive environments use authentic contexts, activities, and assessment. They also involve mentoring and apprenticeships in communities of practice. The result is powerful pedagogy that allows for immersion and intense, extended experiences with problems and contexts similar to the real world. It may not be the game that is effective for learning as much as the immersive multiplayer game environment in which it is set.

One important issue that we must understand, though, is that learning situations in digital games often last, just a few seconds. Thus, analyzing digital games suggests several questions: How are these learning situations arranged within the game temporally? In a learner sequence, a random order, or what? How fast is the learning curve within the game? What is temporal relation between information and the opportunity to apply it? Are there phases, or steps of gameplay? These questions bring the importance of narrative and gameplay in multiplayer digital game environments and why these elements could serve as major players for developing the content for digital learning environments.

5.2 Creating Compelling Context: Narrative and Gameplay

In digital games, gameplay is referred to as activities conducted within a framework of agreed rules that directly or indirectly contribute to achieving goals (Lindley, 2002). A narrative is an account of something that happens to someone (Barrett, 1997). It consists of a series of events, from the background setting to the completion of the game. In other words, gameplay is the actions taken by the players, while narratives are an account of these actions.

Narrative and stories can play an important role in learning (Mott, 2006). Digital game designers use story to ensure the player experiences a coherent narrative progression. In many digital games, story is the 'glue' between missions, providing the necessary goals and motivation for the player to progress to the next segment of the gameplay. In educational game environments, story or narrative can be used to structure the player's/learner's experience so as to achieve specific educational objectives. Narrative can be used to feature challenging tasks, stimulate curiosity by presenting learners with adventures, and provide the necessary pacing to make the learning experience engaging. A key challenge for educational game environment designers is to achieve the proper balance between plot and achieving learning goals.

The player is not only immersed in but is also 'responsible' for the onscreen events. If the game ends it is because of the player's failure, not the deep established reassurance of narrative closure. According to Prensky (2001), one of the foremost characteristics of good game is good gameplay: "Gameplay is all the activities and strategies game designers employ to get and keep the player engaged and motivated to complete each level and an entire game." Good gameplay does not come from the game graphics, but from the continual decision-making and action that engages the learner and keeps him or her motivated to continue. The balance between gameplay

and narrative is important and become more important as we make further examination on how great influential these elements can be in interactive environments.

5.2.1 Narrative

The nature of narrative is complex and the term is used in many different ways depending on the context and nature of the research. Broadly speaking narrative theory focuses on how stories are: 1) narrated – that is how they are told and the linguistic and representational process that are involved; and 2) the narrated events – that is the activity and dimensions of the narrated situation which give rise to the story process. Distinguishing between how the story is told and the events or circumstances which give rise to it enables us to understand certain effects of storytelling, such as temporality, speed and pace.

1) Linear Stories Structure

Linear means that each part of the content is meant to be seen or heard in the same order every time it is experienced. Linear narrative is a traditional form of narrative in which a sequence of events is narrated from beginning to ending without variation or possibility of a user altering the way in which the story unfolds. Therefore, the only point of interaction on the recipient side is to stop or forward the story-process without being able to influence the story's narrative path, or the plot. In a game, a linear story looks similar to a linear story in any other medium, in that the player cannot change the plot or the ending of the story. However, the player still faces challenges as he/she goes through the story, and in fact, the challenges form part of the story itself with player's limited interactions.

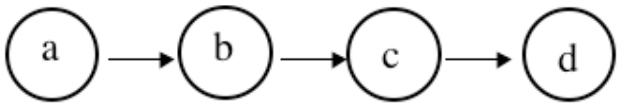

Figure 5.1 Linear Story Structure. One event (a, b, c, d etc.) follows the previous one in a strict sequence.

For the purpose of learning environment, it is certainly the most straight forward and easiest way to develop but this also reflects the limited value in simulating the teaching-learning process between instructor and learner. This linear narrative mode (Figure 5.1) predetermines the flow of information from elementary to more complex topics, very much in the mode of the traditional printed textbook – chapter 1, 2, 3, etc. Since all learners have to follow the single-mode design, the linear design does not accommodate various different learning levels and styles, and certainly it is hard to achieve social learning. Novice, intermediate, and advanced learners all begin at the same point, and proceed through the learning material in the same path. Only the pace of learning may different because the more advanced learner may proceed through the learning materials at a faster pace than less advanced learners.

2) Nonlinear Stories Structure

Henry Jenkins (2002) argued that the obvious problem of applying film theory to digital game is the flexibility of the game universe. A digital game supports different interpretation and routes because it is not characterized by linearity, like other media.

If you allow the player to influence future events and change the direction of the story, then the story is nonlinear which means there are more choices for the player to make, different paths they can take to get from point A to point B, from the game's beginning to its end. There are two most common structures for nonlinear stories: branching stories and foldback stories.

A branching story (Figure 5.2) allows the player to have a different experience each time he/she plays the game. The story offers not one plot line but many that split off from each other at different points. The designer decides on the different possible plot lines and how they relate to each other. During play, the storytelling engine keeps track of which plot line the player is following at any given time. When the story reaches a branch point – a place where the current plot line subdivides – the core mechanics must send a trigger to the storytelling engine to tell it which of the possible branches of the story the player will follow next.

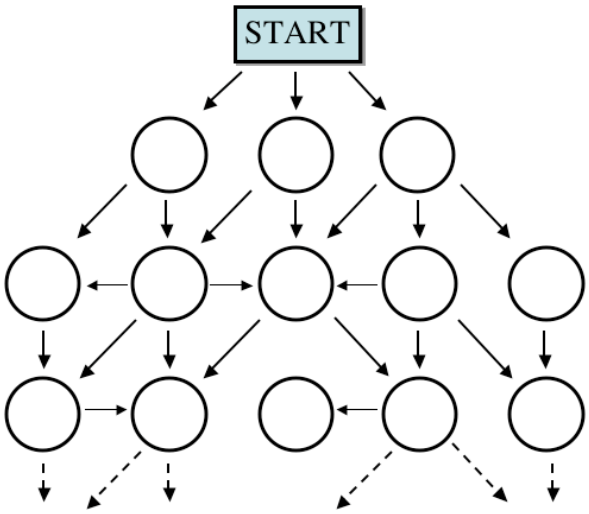

Figure 5.2 Part of the Structure of a Branching Story. A diagram of a branching story looks somewhat like a tree, although by convention the root – the beginning of the story – appears at the top, so that the tree branches out as it goes down the page and the story goes forward in time.

Game events – either player events or in – game events generated by the core mechanics (such as an action taken by AI-driven NPC[3]) – determine which branch the story will take. Player events that influence the direction of the story fall into two categories: efforts to overcome a challenge or decisions that the story asks the player to make. Branch points connected with player decisions have one branch for each option that has been offer to the player. Typically, branch points associated with challenges have only two branches leading on from the branch point, one for success and one for failure.

The foldback story structure (Figure 5.3) is build around a series of key, inevitable events through which a story must progress. In many games, user interactivity allows the player a certain amount of freedom in how they make their way between inevitable events, before

[3] Aritificial Intelligent-driven Non Player Character

foldingback to the inevitable events. Foldback stories support a degree of "replayability". That is, they are capable of keeping the player engaged if they play the game more than once, by allowing them to find a different way though it, even if they know the ending. Where a potentially unknown outcome is essential for maintaining player engagement, the final inevitable event may provide a staging point of several different endings.

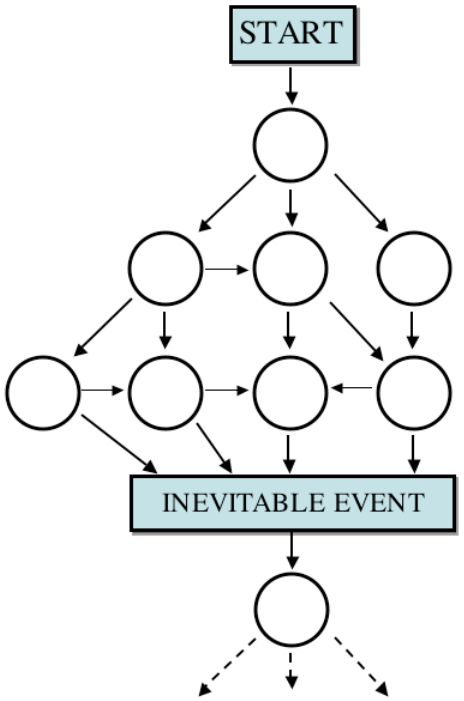

Figure 5.3 Part of the Structure of a Foldback Story.

In Role-Playing Games [4](RPGs), storyline has been told through quests. A quest can be defined as a journey across the game world in which the player collects items and talks to Non Player Characters (NPCs)[5] "in order to overcome challenges and achieve a meaningful goal" (Howard, 2008). Quests often require the player to find specific items that player needs to correctly use or combine in order to solve a particular task, and/or require the player to choose a correct answer from a number of given answers to a certain questions (Beilkova et al., 2008). Upon solving a quest, the player is often presented with a reward, which can have many forms – i.e. ranging from a valuable item to a new skill, trait, or ability for the player's avatar.

Many quests are optional, allowing for freedom of choice in defining the player's goals. Moreover, a set of quests may be mutually exclusive with another set, therefore forcing the player to choose which set of quests he will solve, having in mind the possible long-term effects

[4] Role-Playing Games. The activity involved in role-playing games derives from the assumption by the player of a particular role which has a series of characteristics, skills, and abilities, which the player may define at the start of the game.

[5] Non-Player Characters (NPCs) are characters that are not controlled by the player. Discussed in more detail later in this chapter.

these quests will have on the game world. Some quests can be solved in more than just one way and thus bring non-linearity into the game.

What is noteworthy and important to realize with regard to the focus of this work is the fact that quests are a fundamental structure by which the player moves the storyline forward in RPGs. In other words, a quest is a conceptual bridge between the open structure of RPGs and the closed structure of stories, thus being an idea vehicle for interactive storytelling in RPGs. Consequently, it is possible to use computer role-playing games as a medium for interactive storytelling by dynamically generating non-linear quests.

In contrast to the linear narrative pedagogical, nonlinear or non-sequential narrative environment can provide a true student–centered learning. Learning design shifts the responsibility for mastering a particular subject to the learner. The instructor or pedagogical agent (with NPC), may provide guidance to the learner and determines the guidance to the learner and determines the level of mastery. However, the learner is responsible for mastering the subject through a self-determined path and rate. Such a learner-centered pedagogy will ultimately be more effective than the instructor-centered pedagogy (Felder, 2005).

The design of nonlinear narrative for learning environment, however, is inherently difficult and complex. In such designs, learners might start with same entry point, but they should be able to select any point in the subject, and directly move to any other point in the subject at will without loosing all the content and knowledge that learners and need to gain.

5.2.2 Gameplay

Gameplay is the heart of a digital game's entertainment, the reason players play digital games. Several researches showed that players focus on gameplay as one of the key elements to determine the quality of a digital game (Fabricatore, Nussabaum, & Rosas, 2002). Though, there is probably no universally accepted definition of gameplay.
According to players, they always refer to what can be done in the game, focusing on:

- What the player can do;
- What other entities can do, in response to player's action (i.e. how the game responds to player's decision).

Players are sometime interested also in what happen in the virtual world regardless of their own decisions (i.e. the liveliness of the world), although this doesn't emerge as a relevant focal point in players' comments.

Gameplay often refers to a property of the game itself, namely the nature of the experience that it offers the player, sometimes expressed simply as the amount of time that the game will provide meaningful experiences. Such a definition is given by Rouse – "A game's gameplay is the degree and nature of the interactivity that the game includes, i.e. how the players are able to interact with the game-world and how that game-world reacts to the choices player make" (Rouse, 2001).

Salen and Zimmerman's (2003) definition is similar to Rouse, describing gameplay as "a form of play…a narrow category of activity that only applies to what we defined always as 'games'. Gameplay is the formalized interaction that occurs when players follow the rules of a game and experience its system through play" (p.303). Here, gameplay would be, then, the experience of a formal system, constituted by rules that constraint player agency towards interesting challenges, with intention of achieving specific goals.

Gameplay is an inherently social activity, requiring cooperation and communication among the participants. The process of gameplaying often contains positive peer pressure for socialized behavior (it is more apparent in multiplayer digital game environments). The concepts of fair play and sportsmanship apply to gameplay. Often unspoken group norms exist that define how winners and losers should behave in relation to one another. Conversely, unacceptable group behavior exhibited during gameplay is often punishined in some way, providing opportunities for players to learn consequences of socially unacceptable behavior.

Here are some of the elements that seem to be relevant for gameplay:

- ***Feedback****:* it is crucial to the user's performance in the game and by extension, the ability for the end user to monitor his or her performance. This has obvious relevance to motivate player to improve their performance. Games have feedback embedded in them through achievements, score, health, money, and other tokens within the game world.

- ***Goals****:* What the player of a game has to strive for. A goal is an assignment of value to the possible outcome of a game. Game designers often seek to keep players engaged by creating three levels of goals: short-term (collect the magic keys), lasting, perhaps, second; medium-term (open the enchanted safe), lasting minutes; and finally, long-term (save the world), lasting the length of the game and that the "interplay of these levels, with the support of the environment, is crated to draw players into the storyline of the game (Swartout & vanLent, 2003). It is governed by rules which determine: a) who wins and, often who loses, and b) when and how the game can end. These rules may also specify time limits as well as point accumulation limits leading to success or fail.

- ***Rules****:* Rules are constraints that require players to achieve goals by using specified behavior (Prensky, 2001). Because rules are necessary to games, and because rules constrain players, limiting them to a specific set of behaviors, all game worlds include conflict. In fact, reaching game goals by using only behavior allowed by the rules is how winning is defined. Winning means overcoming the difficulties created by the rules without breaking them. Winning is controlled conflict resolution (Salen & Zimmerman, 2003).

- ***Conflict****:* Conflict is an intrinsic element of all games. Conflict arises naturally from the interaction in a game as players attempt to overcome obstacles to achieve a goal. Conflict also includes the notions of struggle, competition and challenge which motivate the players to maintain their gaming role and make decisions. Conflict can be direct or indirect, violent or non-violent, and may require players to compete or collaborate (often in combination) against the game itself.

- ***Balance**:* Balance in games has two aspects. Either, it is about balancing gamers' chances of winning by focusing on starting conditions or on balancing gamers during gameplay, e.g. by punishing the leader somehow. Or it is about internal balance, i.e. balancing the effect of the different actions or components in the game. Balance, here, is related to varying strategy, since the lack of internal balance can force degenerate strategies and lead to less interesting choices.

- ***Consistency**:* The rules of a game need to be consistent, i.e. non-contradictory, can seem to be obvious.

- ***Challenge***: Not only do games need to offer players a challenge, this challenge must also be interesting and on such a level that the player can overcome it, but not too easily. Also, the challenge has to be tempting. What constitutes tempting of course differs between players. *Novelty* is one aspect; as players explore a game they learn it, and once something is mastered the challenge disappears; it is no longer tempting. *Curiosity*, or the urge to beat someone's high score can be other aspects.

- ***Meaningful choice***: This is closely related to Challenge; since a game's level of difficulty typically increases with the number of choices that are offered to the player; games without choices are not games at all. However, choices in themselves are not enough – players must still feel that there is a point in making them. Making choices meaningful can be difficult; it is a balance between forcing players to make completely uniformed choices and choices based upon perfect information Meaningful choices can be seen as a part of "meaningful play" (Salen & Zimmerman, 2003), but only focused on making decision than on planning.

- ***Control***: Managing game objects, resources within a game. If the player can't smoothly and confidently perform the actions, frustration and boredom will quickly follow. Game over. Control should be intuitive.

- ***Reward***: For overcoming challenges and reaching milestones, a good game will offer some sort of reward. It is important to have a foreseeable ending or goal.

- ***Repeat Playability***: A good way to get players to return.

Some of these gameplay elements are paralleled with the elements of interaction that have discussed in chapter 3 (Table 5.3).

Interaction Element in Learning	Gameplay Element in Digital Game
***Feedback*:** reinforcement, correction, and direction of learning	***Feedback:*** monitoring the performance of game world. Measuring player's progress against the goals.
***Control*:** managing pace, sequence, and learning activities	***Control*:** managing game objects, resources within a game to solve different tasks in pursuit of game goals.
***Participation*:** engaging with the content material by raising thought provoking questions; active participation; providing feedback; building on current knowledge and experience; analysis, comparison, and modification of their own materials.	***Meaningful Choice*:** meaningful authorship in the way he or she plays the game.
***Motivation*:** a product of interest in the content of learning: challenge, fantasy, curiosity, relevance, expectancy, and satisfaction play major roles.	***Goals:*** an assignment of value to the possible outcome of a game. ***Rules:*** constraints that require players to achieve goals by using specified behavior. ***Conflict/competition/challenge:*** are the problems in a game players are trying to solve and these are what makes player excited about playing game. ***Reward:*** for overcoming challenges and reaching milestones in game.
Social exchange and Collaboration: needs to engage in dialogue with others to see various and diverse perspectives on any issue	***Gameplay*** is an inherently social activity, requiring cooperation and communication among the participants.

Table 5.3 Interaction Elements in Learning and Gameplay Elements

5.2.3 Keeping the balance

Narrative and gameplay have conflicting objectives, with gameplay remaining the driver of digital game. Gameplay focuses on establishing rules for the game, providing activities and experience that are unique and consistent with the plot. Narrative defines characters and plots, delivering emotional experience through storyline, dialogues, and narrative structures. Most digital games begin by contextualizing the gameplay within a story world. Characters are created, motivations are given, and gameplay is spaced between narrative elements. A game might begin with narration that sets the feel of the world, explains who you are, and gives you a goal, or reason to play. Narrative elements serve to draw the player in, divide different types of gameplay and signal when the game has been mastered. On one level, gameplay is motivated by the treasures give within the game story.

Hence, digital games can appear to have two narratives: the game story and the meta-narrative of the player's progress, and good games merge those two narratives. While the game sets up the motivation, characters, and story arc, the players are still responsible for telling the story through

the way they play the game. If all stories invite us to identify with the protagonist[6], games are particularly effective in blurring the line between audience (player) and protagonist. Players both identify with, and are the protagonist.

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

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

What a player expects from digital game is giving the player something to do that he or she cannot do in the real world. The trick, then, is to provide enough narrative to create the game world and motivate the player, but not so much as to inhibit his freedom to meet the game's challenges in his own way. The player cannot decide the world in which he plays: that for us, the designers, to determine. But player must be allowed to decide for himself/herself what to do within that world, or there is no point in playing. Too much narrative tends to make the game feel as if it is on rails, the player's actions serving only to move the game toward a predestined conclusion. When the designer takes over too much of the telling, the player feels as if he or she is being led by the nose. Therefore, it is important to find an appropriate balance between the player's desire to act and the designer's need to narrate.

5.3 Digital Characters

The characters are the agents that carry out the story plan. A character is defined by an internal state, which is initialized by the story author. In the fields of literature, film, and other media studies have long argued the importance of characters to stories (Egri, 1960 & Forster, 2000). Similarly, events in games can be interpreted as a story and also here characters are important: characters and intentions are central in structuring events in intelligible form. However, the inherent interactivity of digital games raises a question a new requirement: how should characters be designed for games in order to support the interactive experience of playing a game?

In digital game environment, there are two types of characters that are populated as the inhabitants: Player Characters (PCs) and Non-Player Character (NPCs),

[6] The *protagonist* is the main character in game. The protagonist must always drive the game story forward.

5.3.1 Player Character (PC)

The player character is the most important communication tool for a player within a game: it is the basis for the player's self-identification, as well as for other players' behavior. Whether human being, furry animal, or alien creature, the character controlled by the player is that person's physical, social and emotional suit within the game. Also, to a large degree, players experience and interact with the world through their player characters (PCs) as PC's motivation and missions are decided by the storyline.

In digital game environment, character management is one of the key features. In many digital games, players begin by creating a character they will play. Typically, players are presented with a variety of base-characters from which to select. Players customize their characters by choosing from a limited number of traits, skills, adornments and attributes. These limits force players to make decisions about the types of characteristics in which to endow their characters. In the course of gameplay, players have opportunities to enhance their character's skills and attributes, and adornments and this impacts how a player's character advances in the game. When collaborating with others, a player's skills, attributes, and adornments often indicate the potential contribution a player may provide when participating in collaborative events, which in turn may impact the type and amount of invitations to collaborate with other players.

There are two levels of a player's psychological experience of player characters: emotional feedback and social affordances. In the emotional level, player character is the sensory experience that a player has of that character, particularly in the sense of feedback from the character to the player as he or she takes action. When a person "plays" a person character, she or he takes on the player character's body in the game world and adapts his or her reactions to the affordances of the game world and to the capabilities of the player character. Conscious consideration of the emotional qualities of a player character can produce much higher player satisfaction and engagement with that character.

Facets of emotional feedback include what sorts of physical powers the character has, how it feels to control them and to move through the world, and the general effects that actions have on the senses (usually limited to sight and sound, sometimes touch). For example, sports games usually give player characters a much greater level of athletic ability – strength, speed, and reaction time – than the player likely has in everyday life. Every game has a unique way to apply emotional feedback, and when there is a player character, she or he becomes the surrogate body for the player through which the emotional qualities of the game world are experienced.

Another level is social affordances. To the extent, player characters are part of a social world that give context to the game, either between players or among player-characters and in game non-player characters. There would be variance in social standards, depending upon gender, culture, and other variables in game environment, which are learned over time. The player will be trying to make sense of the game world in part through the lens of the player character's social capabilities and context: 1) With player character, the player senses the social presence; and 2) player characters also model the social role and emotions the player should be inhabiting in a game world through their actions and reactions toward NPCs. To have a greater engaging experience for player, player character needs the right social affordances for the gameplay situation at hand, from clear social role and personality, as explain to the player in the beginning

of the game, to customizability of appearance and social cues in multiplayer situations. The player will feel more immersed in the role of the player character to the extent that NPCs reflect the player's social role and qualities back to him or her during gameplay.

5.3.2 Non-Player Character (NPC)

An NPC is a character in the virtual environment that is not controlled by player. These characters are developed and scripted by the game developer and controlled by the game's artificial intelligent (AI) engine. NPCs exist for the player to interact with in some way and most of the time players interact with NPCs through dialogue. Most role-playing games features branching dialogue. As a result, when talking to an NPC, the player may choose from a list of dialogue options where each choice often results in a different reaction. Such choice may affect the player's course of the game, as well as latter conversations with NPCs (Figure 5.4).

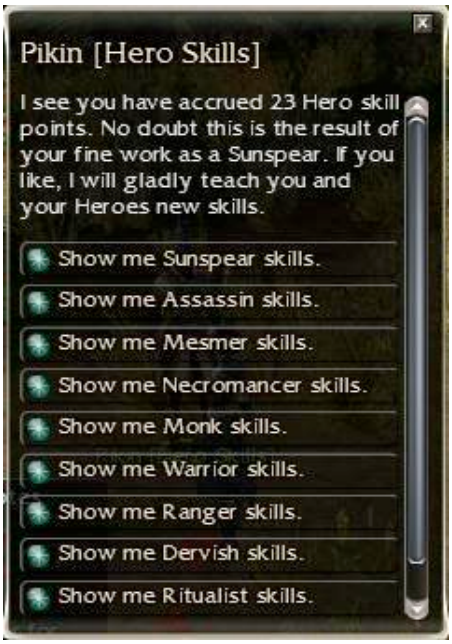

Figure 5.4 Sample NPC dialogue from World of Warcraft[7]

The dialogue structure between the player and the NPC can be thought of in the same way as game narrative systems. A dialogue structure can be:

- Linear: Player walks up to an NPC and choose the "Talk" command. Then NPC tells player something. Interaction ends.
- Branching: Player initiates a conversation. The NPC says something, and the player is given a choice of responses. Based on my response, the NPC may way something else and then give me a brand new set of responses.

[7] World of Warcraft, often referred to as WoW, is a massively multiplayer online role-playing game by Blizzard Entertainment. www.worldofwarcraft.com

- Parallel: Player initiates a conversation. The NPC says something, and the player is given a choice of responses, the NPC responds, and so on. There are several combinations of responses that can get the player to the same outcomes, however.
- Dynamic: Player goes through a branching or parallel conversation. Depending on the outcome, the player proceed to a new conversation (or a new area of exploration within the current conversation)

The NPCs have a range of objectives in games and may have various abilities that are useful to the player. The NPC is important not only for a character in a generated story, but also as part of the solution to a puzzle. While the puzzles are not always meaningful in the sense that a great riddle can be, they do constrain the interaction so that the potential narrative of game is realized in please way, not only requiring that player spend time near some of the NPC but also acting to withhold and divulge secrets in a way that keeps the player interested.

Beyond the ability to provide physical or mental assistance in fighting, solving puzzles, or just in learning the ropes of the game world, a friendly NPC may also be able to provide moral support in achieving game goals; cheering, excitement, approval, and the like. NPCs may also provide companionship for the player or may provide a social motivation in the form of someone who needs rescuing. Even unfriendly NPCs have abilities that improve the player's experience, providing opposition and conflict – both physical and emotional – the enhances the player's experience. NPCs in neutral roles can provide social validation for the player when they approve of her his actions and help spur better play when they boo a bad performance.

Sometime, NPC can be used to inhabit the living world the game creates. A game-world may be infinitely detailed in terms of the objects it contains and how it looks and sounds, but players are used to a real world which also contains living organisms that think for themselves and behave in interesting ways. Therefore, ambient life in a game goes beyond just establishing that setting; it helps make the player feel less lonely in the game-world.

In learning environment setting, NPCs can be designed various ways to enrich individual learning context. One of the most perceivable ways to design NPCs is as virtual instructors/facilitators. These characters can benefit learning in two ways: learning motivation and learning experience. These NPCs can be designed in such way that they may use for motivating the player/learner, reinforcing learning concepts, and providing guidance through new and complex tasks. Learners also carry out missions in a digital game environment, interacting with NPC, and NPC can assists the learners if they run into difficulties, and give performance feedback in the context of preparatory exercises.

In a learning process, learners need positive feedback when they are frustrated, domain-related guidance when they have certain questions that are beyond them, and support when they want to give up. This can be improved by NPCs in a digital game environment. NPC could be an expert who can provide an expert-like solution to the problem in a specific domain. It consists of propositional networks of chunks of facts and procedural rules in the form of if-then clauses. Also, NPC could be used to decide when feedback can be given to a learner with a specific performance level at an appropriate time. The feedback could be in the form of positive or negative responses. Different types of feedback will be used to motivate players/learners and

facilitate learning. For example, during the game, NPC could decide in real-time to: 1) encourage players/learners (e.g. showing in-game status); 2) congratulate players/learners (e.g. using text like "congratulation"); 3) give reasons (e.g. showing in the thought bubble why certain formulas are not correct); 4) challenge players/learners (e.g. time, performance scores); and 5) provide hints, questions, and suggestions (e.g. the NPC may point out that purchases exceeding the maximum amount is not allowed).

Similar to commercial digital games, beyond the ability to provide physical and mental assistance to the learner/player, NPC can be designed to provide opposition and conflict – both physical and emotional – to enhance the learner/player's experience, add more motivation to participate, and to complete the tasks/puzzles.

Another way to design NPCs in learning environment is as part of the 'context'. These NPCs can be populated in game world and even limited or no interaction with them, player/learner can learn some of the activities and opportunities that occur in the game world by observation. Also, these NPCs could set the initial frame of expectations or behaviors that player/leaner can learn and apply in the game world.

5.4 Digital Game and Learning Environment

Arguably, as shown in Table 5.4, digital game elements that are discussed in this chapter can be paired with the elements of learning environments that discussed in chapter 3.

As mentioned earlier in this chapter, narrative and gameplay help to generate the interaction of player and game, and both of them can be a powerful instructional strategy. Also, NPCs can be designed in various ways to provide both guidance and engaging experience to the learner. All these elements contribute and shape the content of digital game learning environment and the learning experience for the learner that:

- Narrative and gameplay that drive learning activities; and
- Dynamic intelligent NPCs who offer information about content presented in the three dimensional space, directions regarding play and learning activities, and opportunities for remediation related content.

Learning Environment Element	Digital Game Environment Element
Context (when and where): consists of the environment, circumstance, and events that impact a learning activity, program, or task.	***Virtual Environment*** as a platform Structure, time & location of game world; Contextual information of the game world.
Content (what): the information that is contained in a resource and that is intended to affect a change in cognitive state; subject matter	***Topics*** or ***subject*** matters in the game
Pedagogy (how): the methods, strategies, and tactics to organize the content to affect and measure of learning	***Narrative:*** an account of something that happens to someone (Barrett, 1997). It consists of a series of events, from the background setting to the completion of the game. ***Gameplay:*** the experience of a formal system, constituted by rules that constraint player agency towards interesting challenges, with intention of achieving specific goals: feedback, rules, goals, challenge, conflict, control, etc. ***Non-Player Character (NPC):*** AI that interacts with game environment and the player
Participant a, Learners (who): an individual involved in the acquisition of knowledge or skills	A players with ***Player Character:*** A person who interacts with a game
Participant b, Facilitator/Instructor (who): a person who facilitates and bridges between the learners and the learning sources (Content)	***Game Creators:*** People who design the game ***Facilitators:*** People who are responsible to structure and help player ***Non-Player Character (NPC):*** AI that interacts with game environment and the player

Table 5.4 Learning Environment Elements and Digital Game Elements

5.5 Assessment for Learning

The allure of using digital games for learning is their potential to provide multiple benefits, including a complex and diverse approach to learning process and outcomes; high interactivity and engagement (flow); immediate feedback; enjoyment; problem solving; scaffolding; user control; adaptive challenge; contextual learning; ability to address cognitive as well as affective learning issues; and motivation for learning (Kirriemuir & McFarlane, 2003; O'Neil, Wainess, & Baker, 2005; de Freitas, 2006). Digital Games have the potential in immersive environments to help learners develop cognitive readiness, and self-monitoring skills and to engage with content in greater depth and sophistication than the typical classroom experience allows.

The real question is, *how do you know?* "Figuring out if somebody learned something is a very difficult task," says Jonathan Ferguson, Interaction Designer at the EduMetrics Institute in Provo, Utah. Assessment is a huge topic and is a very broad term that can have very different meaning depending on the context. Nevertheless, there is general agreement that assessment in the context of education involves deciding, collecting, and making judgments about evidence relating to the goals of the learning being assessed. Assessment is both a process and a tool to

determine what the learners have understood the material and can be expected to recall and use the material appropriately.

In traditional classroom settings, instructors have used quizzes, recitals, competitions, and a variety of other testing methods to see how well their students have learned the materials. In most cases, teach and test, teach and test, the cycle repeats itself over and over throughout the process of learning. For the instructor, the student, and any other interested parties, the purpose of this continual testing is to demonstrate proof of learning.

In digital game environments, learners are in actions. In playing games, players naturally produce rich sequences of actions while performing complex tasks, drawing upon the very skills we want to assess (e.g., critical thinking, problem solving). Evidence needed to assess the skill is thus provided by the player's interactions with the game itself – the processes of play, which may be contrasted with the product(s) of an activity, the norm within educational settings. Making use of this stream of evidence to assess skills and abilities presents problems for traditional measurement models used in assessment. First, in traditional tests the answer to each question is seen as an independent data point. In contrast, the individual actions within a sequence of interactions in a game are often highly dependent on one another. For instance, what one does in a flight simulator at one point in time affects subsequent actions later on. Second, in traditional tests, questions are often designed to get at one particular piece of knowledge. Answering the question correctly is evidence that one knows a certain fact; i.e. one question – one fact. By analyzing students' responses to all of the questions, each providing evidence about students' understanding of a specific fact or concept, teachers or instructional environments can get a picture of what students are likely to know and not know overall. Because we typically want to assess a whole constellation or skills and abilities from evidence coming from students' interactions within a game or simulation, methods for analyzing the sequence of behaviors to infer these abilities are not as obvious.

5.5.1 Practice in digital game

Most people perceive digital games as nothing more serious than hour upon hour of mindless entertainment, but James Gee, *What Video Games have to teach us about learning and literacy*, argues that the best digital game designs demonstrate sound educational technique. Specifically many games designers build complex learning and progressions into their games. In the game development industry, these are called, "tutorials." Tutorials present the players with the basics of how to control and interact with the game and then test the player on this information with a series of levels or missions. Tutorials missions often introduce only a few new game features or play elements at a time to avoid overwhelming the player. By the time the player has completed these first few missions, he or she has "learned' the essentials of the game and can be bombarded with ever greater in-game challenges. This process continues past the tutorial, because later levels and missions in the game become increasingly difficult.

Another well-known assessment in digital game is scoring. Typically, the game's scoring mechanism, such as the number of contacts made, obstacles overcome, and so on, is tallied against a time bar. This provides the sense of an evaluation of performance, and when summarized, scores can be inferred to represent something, like a competitive position in a distribution of players or proficiency along some continuum of performance. The scoring system

teaches the player what is important within the game. A positive score indicates a good choice, a negative score a bad choice, and no score at all indicates that the attached action is probably unimportant. In the same way, the education strategy of teaching to the test clearly identifies to the student what is important to learn and what can be ignored, as in-game scores do in digital games.

5.5.2 Design challenges

For digital game learning environments, both the medium of digital game itself and its newness create certain challenges that can make assessment difficult and raise questions:

- With less emphasis on rote memorization of facts, the assessment obtained from traditional methods may not accurately reflect the learning gained from digital games. What is the appropriate assessment for digital games?
- Open-ended simulations can support a wide range of possible solutions. Which one is more accepted?
- When teaching abstract skills such as teamwork and leadership, how do you measure learning and/or improvements?

So far, there are three types of assessments used in digital game studies for learning:

- ***Completion*** – Did the player complete the lesson or pass the test?
- ***Pre-and-Post Questionnaire*** – How much information or understanding has been gained by the player?
- ***In-process*** – How did the player choose his or her actions? At what point? And so on.

The simplest form of assessment is assessment of completion: Did the learner complete the game? In traditional teaching, this is equivalent to asking, "Did the student get the right answer?" Because games require interaction by the learners with the material, completing the game could signify more learning progress and comprehension than passively attending lectures in a typical classroom setting. However, this type of assessment falls short on a number of counts. Besides the possibility of learners exploiting holes in the game system, it is important to know whether the learner learned the material in the game, or just learned the game and how to beat it.

Another popular form of assessment is a pre-and-post questionnaire. This method allows for an initial benchmark to be established, followed by a measure of how much students improved. Though, questionnaires are commonly used and often misused. A questionnaire is a highly structured method of gathering information. It has the advantage that it is easily administered, but the disadvantage that written words can be interpreted differently and clarification is not possible. These are potentially valuable sources of information, but are often designed and interpreted poorly.

In-process assessment is probably the most effective and appropriate way to assess the learning activities in digital game environment, but it is difficult to apply. In-process assessment is similar to teacher observation of the student as the student performs the task or takes the test, as part of formative assessment. Formative assessment is a process by which instructor gather information about what learners know and can do, interpret and compare this information with their goals for

what they would like their learners to know and be able to do, and take action to close the gap by giving learners feedbacks as to how to improve their performance and guiding student toward obtaining their goal(s). The most helpful feedback provides specific comments to students about errors and suggestions for improvement. It also encourages students to focus their attention thoughtfully on the task rather than on simply getting the right answer (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Shute, 2007). This type of feedback may be particularly helpful to lower-achieving learners because it emphasizes that students can improve as a result of effort rather than be doomed to low achievement due to some presumed lack of innate ability (e.g., Hoska, 1993). However, developing and employing the formative assessment in digital game learning environment is difficult because all those different task selections and feedbacks require a very organized and thoughtful design process in early design stage.

In-process assessment brings back to the important role of NPC in digital game learning environment. Though it would be ideal if the instructor can observe and provide in-game feedbacks on learner's progress throughout gameplay, but, as mentioned earlier in this chapter, a NPC can be designed in various ways to assists the learners including in-game feedback. NPC is important for a character in a generated story in the digital game world, but also could be used to assess the learner's progress and to decide when feedback can be given to a learner with a specific performance level at an appropriate time. NPC could assist the learners if they run into difficulties, and give performance feedback in the context of preparatory exercises. Also, NPC could capture and process the data of the learner's progress and alert the instructor for learner's performance throughout gameplay. Other than getting assessment by NPC, both game narrative and gameplay could be designed to support on to reassert an interpretation or to provide extra task to help the player improve in areas where they are weak.

5.5.3 The Thinking Aloud Method

When conducting a usability test, independent of the product (game) or service that is being tested, the researcher ideally would like to be able to look *into the head* of the participants in the test: What are they thinking, what is their reasoning to select particular options and ignore others, what attracts their attention, and what not, how do they interpret the different labels, colors, icons, and other elements being presented to them? Current technology, unfortunately, does not yet provide us with the means to have a detailed record of the cognitive processes taking place in participants' brains while interacting with a device that would allow one to answer such questions.

However, there are ways to catch a least a glimpse of what might be going on inside the head of a participant. Asking participant to think aloud while working through the tasks presented to them in a test situation is one approach often used in usability testing. The reports of such verbalizations are called verbal protocols.

The use of verbalizations as indicators of cognition is a decades-old data collection technique. Psychologist Karl Duncker (1945) originally described think about verbalizations as "productive thinking" and a way to understand his subjects' development of thought. Forty years later, Ericsson and Simon (1984) posited that thinking aloud data collection is a valid method for researching cognitive processes. According to the authors, thinking aloud methods draw on thoughts in the short-term memory of subjects. Because all cognitive processes travel through

short-term memory, the conscious thoughts of the subject can be reported at the time they are processed. According to Ericsson and Simon, the cognitive processes that generate verbalizations ("thinking aloud") are a subset of the cognitive processes that generate behavior or action.

There are both advantages and disadvantages to using information drawn from thinking aloud data. The main advantage of the method is the wealth of qualitative data it can collect from a fairly small number of users. Also, the user's comments often contain vivid and explicit quotes that can be used to make the test report more readable and memorable.

Conversely, Branch (2000) identified disadvantages of the thinking aloud method. She found that the cognitive load of problem solving and speaking may be too difficult for some subjects, in essence, multitasking. Also thinking aloud may even change the way the task could be performed, for example, because the participant realizes while verbalizing that the task could be performed in a different way. Also, when there is more than one way to perform the task, the respondent might go for the one that is most easily described. Furthermore, thinking aloud might result in the participant performing the steps in a task in sequence rather than at the same time as would be normally done. These problems can be mitigated by using reflection data. Branch (2000) and Fonteyn, Kuipers, and Grobe (1993) all found that asking post-process questions to subjects provided valuable information that made think aloud data easier to understand and interpret.

Therefore, the thinking aloud method needs to consider a two-step process to be more practical. In the first step, researchers first collect date in real time, asking subjects to thinking aloud. During the process, researchers probe subjects as infrequently as possible because subjects are easily distracted during problem-solving activities (Ericsson & Simon, 1984). When silences continue for several seconds, researchers merely probe the subject to "keep talking." Neutral cues such as "keep talking" encourage subjects to thinking aloud but do not bias the data by adding external ideas to the internal process of subjects.

Once the think aloud process is complete, the second step of this method is to ask follow-up questions. Answers to these questions are not the primary data source, but can supplement any unclear date derived from think aloud techniques. Such questions may also be useful for subjects who are unable to meet the cognitive demands of thinking aloud while problem solving (Branch, 2000).

5.6 Multiplayer Online Game (MOG)

In a Multiplayer Online Game (MOG), multiple players may participate and interact with each other within a shared game scene through the Internet. Unlike single player game, players in MOGs are involved in some form of competitive play, or non-competitive, interactive play addition to individual quests. Players are typically rewarded for both their efficiency in role-playing their virtual characters and the collaboration with other players. As the player complete quests and overcome conflicts, his/her character advances in levels and becomes stronger. Ideally, these actions and interactions should affect the virtual world and shape the storyline accordingly.

Mayo (2007) describes six effective learning paradigms which re inherent to an MOG:

- *Experimental learning*. Players make decisions and discover the consequences
- *Inquiry-based learning*. Players set goals for themselves and determine how to achieve the goals through experimentation.
- *Self-efficacy*. Points, items, etc. are earned by the players, encouraging them to continue.
- *Goal setting*. Players set goals to achieve within the game.
- *Cooperation (team learning)*. The game encourages players to work together towards a common objective.
- *Continuous feedback*. The game provides constant feedback on the player's performance, adjusting the difficulty level to meet the player's needs.

As discussed in chapter 2, Lave and Wenger (1991) argued that meaning is contextual, and learning is what happens when individuals become increasingly involved as participants in social communities of practice. This is particularly relevant to MOGs because they are complex discursive communities characterized by a "full range of social and material practices" (Steinkuehler, 2004, p.9). These social spaces can potentially encourage information sharing and collaboration both within and beyond game parameters. Hertz (2002) observes that these networked game environment "fully leverage technology to facilitate 'edge' activities… the interaction that happens through and around games as players critique, rebuild, and add on to them, teaching each other in the process. Players learn through active engagement not only with the software but with each other" (p. 173).

In addition to their social character, MOGs are uniquely engaging environments. Peng (2004) notes that, "students can learn in a flow state where they are not just passive recipients of knowledge but active learners who are in control of the learning activity and are challenged to reach a certain goal" (pp. 10-11). Garris et al. (2002) agree, pointing out that "motivated learners more readily choose to engage in target activities, they pursue those activities more vigorously, and they persist longer at those activities than do less motivated learners" (p. 454).

Bender (2005) points out that the MOG is particularly well suited to role-playing activities. In a role-play, the participants play a 'role' in a specific situation or scenario. This usually means that the story comes to revolve around the player's character that becomes the center of the action. They can play their own part or someone else's in a safe environment where they can act, experiment, learn and teach with no risks of irreversible consequences (Ladousse, 1987) and such emotional states might encourage them to learn. As the players are experiencing the game process, they also obtain some learning experience, and their acquisition of knowledge accumulated. So at the end of the game, the knowledge and abilities the instruction goals provided is also achieved.

These types of immersive MOGs let players participate in new worlds, inhabiting roles that would otherwise be inaccessible to them. They allow people to experience the ways a particular discipline thinks about and solves problems – as a physicist, an entrepreneur, an investigator, a news reporter, and so on. In this way, games are coming to represent 'distributed authentic professionalism.' Knowledge and skills are built into the virtual characters, objects, and environments. These types of games distribute expertise among the virtual characters and real-

world players, requiring players to master the skills they do not have and integrate them with other members of the virtual community. They require the player to adopt a certain set of values and a particular worldview that is connected to performing activities within a specific domain of knowledge. More than just games, they are networked communication systems with interactive chat and messaging. Requiring one to become a member of the community (or guild) exposes novices to the ways professionals deal with problems, mirroring the practice of becoming an expert.

After much of discussion about the educational advantage of MOG learning, the actual problem we face is how to design and develop such environments for learning. The following chapters deal with the discussion of developing a MOG that can potentially serve as a learning environment for school age children, and the Virtual West Oakland (VWO) project has been used as a case study.

Virtual West Oakland (VWO) is a virtual 'World,' intended to introduce school-age children to the lost African American cultural heritage of Jazz and Blues music that flourished on Seventh Street in Oakland, California, in the 1940s and 1950s. The project serves the test the ability of this new medium, not only, to communicate cultural heritage, but also to foster a new learning environment. There were many attempts to teach rich history of Seventh Street, including newspaper reports, audio recordings, and photographs, but the common difficulties associated with these media were passive and unable to engage their audience in the vibrant life of Seventh Street.

Thus we have developed an interactive narrative, through which visitors experience the street as it was in the 1950s in a virtual game environment that teaches the rich history to school-age children. It comprises of a series of quests, which visitors perform to gain a sense of the music and 'mood' of Seventh Street in the 1950s. In addition to interacting with each other, the visitors also interact with Non-Player Characters (NPCs) that impart to them short stories about the life in Seventh Street. We assumed that this kind of virtual environment could lead constructivist, contextualized, and socially-rich learning where such worlds can put participants in contact with others in an immersive environment that challenges them to figure out things for themselves, and their playful nature could foster engagement which contributes to the learning process.

The project had been a joint effort by graduate students in the UC Berkeley Architecture Department, Digital Design Research Group led by Professor Yehuda Kalay and Graduate School of Journalism, led by Professor Paul Grabowitz.

Chapter 6: Virtual West Oakland (VWO)

6.1 Project Description

In the 1940s and 1950s, Seventh Street in West Oakland was bustling commercial district, anchored by dozens of jazz and blues clubs that earned a reputation as a West Coast rival of the Harlem music scene. The clubs were a mecca for musicians from around the country who made West Oakland an essential stop on their tours. Legendary blues and jazz singers and musicians, including Jimmie Witherspoon, Sugar Pie DeSanto, B.B. King, and Aretha Franklin, performed there. Complementing the clubs were numerous other business establishments up and down an eight-block stretch of Seventh Street – Restaurants and cafes, clothing and drug stores, pawn shop and pool halls, numerous hotels – all of which made Seventh Street on Oakland's major commercial and retail center at the time. Seventh Street was not only influenced by African American migrating from the South that defined the street with music, the street created the community that prided itself on its diversity and the relative lack of racial animosity in their community.

Figure 6.1 Slim Jenkins bar/restaurant, West Oakland, c. 1950

However, by the mid 1960s this remarkable part of Oakland was all but destroyed, the victim of a number of different urban redevelopment schemes over the years: a major freeway was built, cutting the neighborhood off from the rest of Oakland; an elevated rapid transit line (BART) was erected in the middle of the street; and 12 blocks of residential and commercial buildings were demolished to make room for a regional postal distribution center.

Today a walk down Seventh Street reveals almost no hint of the vitality of the area and the once thriving jazz and blues club scene. Although much of the music has survived in recordings, the

architectural, cultural, and social components of this important African American heritage have all but been lost. The street is marked by boarded up buildings and empty lots and plagued by drug dealing and crime. Only one club from the 1950s remains, the neighborhood is dilapidated, and much of its heritage is known only to its older residents, many in their 80s and 90s.

The story of Seventh Street has been told in bits and pieces over the years in a variety of different media, but none of these have told the story of the Seventh Street to the readers or viewers to truly "experience" what Seventh Street was like. Attempts to teach this rich history to school-age children suffer from abstraction and detachment from these media and hard to communicate 'mood' of a bygone place; books, photographs, and documentary films are passive, detached media, which have difficulties to engage their audience in the vibrant life they purport to communicate.

To recreate the experience of what Seventh Street was truly like, we have chose the format of the advent of new media, digital game environment, that could provide us with the opportunity to develop an immersive, interactive narrative that will help visitors experience Seventh Street as it was in the 1940s and 1950. It is 'inhabited' by avatars representing individuals participating in activities within the street, and includes buildings, the people, and most importantly – their activities and their culture.

6.2 Design Questions in VWO

There were many elements that we integrated into VWO. Throughout the process of designing VWO, we raised the basic tasks and questions that guided us to develop VWO:

- Determine storytelling goal – What kind of story do we want the digital game to support? What genre would it be for VWO?
- Determine the storytelling context - Where is the story set (e.g. restaurant, pawnshop)?
- Determine target group - What age ranges are we interested in supporting?
- Determine learning goals - What particular aspects of storytelling do we want to support:
    - What kind of learning experience we want to provide? With good characters?; With narratives?; Creating nonlinear narrative?; Developing good scenes?
- Determine the digital game world interactions – How do we want the players to be able to interaction with the world:
    - How big is the game world and will players have a map of the world?
    - How do players interact with each other, NPCs and other game objects?
    - Are interactions indicated by text and graphics?
    - What would be the best way to structure different types of interaction?
- Create convincing narrative and gameplay – How we are going to design game narrative that supports multiple choice and storyline? Is there 'dramatic' moment of the story? Which graphically represents moments of tension and conflict within the game?
- Create meaningful characters – How different attributes of game characters will influence the game experience for the player?
    - Appearance attributes – How to design visual hooks of characters with appropriate looks for the historical time period, such as clothes and accessories?

- Emotional attributes – How to create game characters that enhance player's engagement to its character and storyline?
- Relationship attributes – How to design the characters relationship to their environment and other that drives a story? How to provide the visual cue for different relationship between characters and their environment?

6.3 Developing the Content

In order for us to construct a digital reconstruction of Seventh Street, we had to find the appropriate documentation that describes that built environment and the objects (trams, cars, street furniture, etc.) for the period being reconstructed. It was important to find the accurate information on Seventh Street as much as possible not only for the motivation of providing the players/learners could experience in the authentic context, but the information of material arrangements and space would play a significant role to influence the players'/learners' interpretation and understanding about the world. Also in some degree, it allows the players/learners define who they are and what they are doing in that environment.

Some of still existing building were photographed, measured, or digitally scanned, providing a basis for the reconstruction. However, most of buildings did not survive due to the extensive urban development that has literally obliterated entire blocks of building, and significantly modified the remaining ones. We spent a great amount of effort to find the documentations and photographs from a number of different libraries, museums, public agencies, and news media that had photo archives of Oakland, getting street scenes of Seventh Street from the 1940s and 1950s, and we did face difficulties of either accessing these places with some complications or finding the right sources.

In addition to using traditional research methods to recover the documents and photographic evidences, we reached out to the community in several different meetings of Seventh Street 'old timers' organized and promoted by the Oakland Post, the black community newspaper in Oakland that cosponsored our project, where we gathered more old photos and oral descriptions of some of buildings and street scenes from the people attending the meetings. The meetings were helpful but, again, still a large quantity of information that we need to construct the Seventh Street was missed. As a result, the re-creation of many of the buildings on Seventh Street had to reply in large part on using photographs of a few blocks of Seventh Street or of other nearby commercial streets from the 1940s and 1950s to produce generic representations of the buildings (Figure 6.2).

Figure 6.2 Slim Jenkins, VWO

In VWO, we decided that all buildings were rendered in gray scale except those buildings that would be directly used for our game narrative and gameplay, with two reasons: 1) because all our photographs from the 1940s and 1950s were in grayscale that we wanted to respect the resources that we had collected; and 2) during the gameplay, the differentiation between interactive and non-interactive place would be more effective for the players/learners to identify the places for game narrative and gameplay (Figure 6.3).

Figure 6.3 Street View, VWO

Lastly, the time of day was set to be early evening, while there is still enough light to see objects and characters clearly, but late enough to support the storyline when bars are open.

6.3.1 Implementation Tools for VWO

We chose to use 3D Studio Max, a conventional modeling software, to model of 18 city blocks (10 city blocks for main interaction for the game stories and 8 city blocks for the backdrop of the game environment) of buildings, street furniture, and other objects that were needed for the site. Then the models were being implemented in Torque[1], a game engine[2] that allows multiple online users to be 'immersed' in the world, and freely interact with one another within the simulated environment.

During the stage of project implementation, we had faced some technical challenges of what the Torque can and cannot do, and we had to decide on a number of issues including: 1) the number of character that can be present onscreen at once, 2) the number of animations per character; 3) camera and game view restrictions; 4) the number of polygons available per level and character; and 5) the number of colors per texture map.

6.3.2 Basic Functions in VWO

1) Control Mode and Basic Controls

The game is controlled through the keyboard and the mouse (Figure 6.4). A player can access to the keyboard mapping by pressing [F1] or help icon, , on the lower right corner. The W, A, S, D keys are used to move around the world. A player can move his/her camera by holding the left-click and dragging the mouse cursor. Right-click is used for interacting with objects (jukebox or piano) or NPCs.

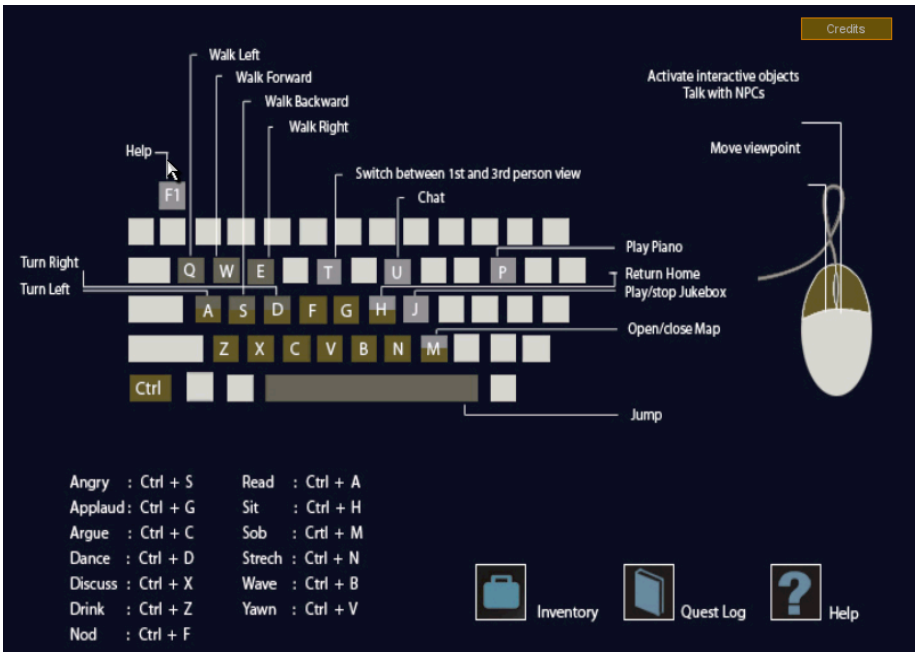

Figure 6.4 Keyboard and Mouse Mapping in VWO

[1] Torque Game Engine (TGE) is a 3D game engine made by *GarageGames*.

[2] The (game) engine is the software which provides the basic architecture of the game but not the concrete content. The game engine handles the artificial intelligence (how computer-controlled units act), the audiovisuals, and the physics (e.g. the effect of bumping into wall, and the effects of gravity).

2) Interaction with Others and status updates

A player can find updates of his or her game status in the transparent window on the lower portion of the window. This window is also used to communicate with other players (Figure 6.5).

Figure 6.5 Chat and Status Update Window

3) Interaction with NPCs

As the game default, Player character is in shoulder point of view. To talk with NPCs with  symbol above their heads[3] to get information to proceed, a player character has to change into first-person view from shoulder view, then right click on NPCs to initiate dialogue (Figure 6.6).

Figure 6.6 Henry NPC with an interaction symbol above his head.

[3] Note that not all NPCs will talk with PC in VWO.

NPCs can only interact with only one player at a time and NPCs will talk to players/learners via dialogue box. When the NPC is interacting with a player/learner,  symbol turns into red to indicate that this NPC will not be available to other players until current interaction is over (Figure 6.7).

Figure 6.7 During the interaction (in this case, with Burton NPC)

6.4 Characters in VWO

As discussed in Ch.5, the characters are the agents that carry out the story plan. The state of a character is changed due to interaction with other characters. It also influences his or her actions and reactions in game world.

In VWO, we needed to develop a wide range of characters, like characters for the players and for the interactive NPCs and bots[4], who would resemble some of the real people inhabited on Seventh Street in the 1940s and 1950s. We relied, again, on photographs and other information that we gathered from various places, including the memories of people who lived or worked on Seventh Street or in nearby neighborhoods who were interviewed for the project. Unlike the difficulty of finding information on built environments on Seventh Street, we had a large amount of biographical information on dozens of musicians, club and business owners and other prominent people to help with character development for the project.

We incorporated this information into VWO world by writing interactive dialogs in which the player could engage in a conversation with an NPC in two ways: 1) asking a series of questions that would prompt the NPC to recount details about personal history of their own, or 2) receiving or completing tasks that are given by NPC (further discussion on narrative structure and gameplay in VWO later in this chapter). Thus the player could learn about many of the main characters of Seventh Street – Raincoat Jones, Slim Jenkins, Bob Geddins, C. L. Dellums – by

[4] Bots are characters in a game that are controlled by the AI, and typically, they are programmed to interact among themselves or their surroundings but not with player characters.

engaging them in conversation directly or by interacting with other NPCs who would also provide information about the history of Seventh Street.

We also created the bots to populate on Seventh Street in VWO: 1) to help making the players feel less lonely in the game-world; and 2) to show the players some of the activities that occur in Seventh Street so the players can learn or adopt the cultural knowledge that they can possibly apply while the are in VWO. Table 6.1 shows the list of NPCs that are directly interacting with player character throughout the game.

NPC	Location	Description
Bartender	Harvey's Rex Club	A Bartender who worked in one of known clubs on 7th Street.
Jewel Brown	Pullman Hotel	A Pullman Porter union member.
Mr. Burton	Burton's Clothing Store	The owner of Burton's Clothing Store on 7th Street.
C. L. Dellums	International Brotherhood of Sleeping Car Porters	A vice president and head of the West Coast office of the International Brotherhood of Sleeping Car Porters and took records done by black musicians and helped to sell them in every town that train stopped.
Lowel Fulson	Seaman's Mission	A blue musician who made his mark on 7th Street in the 1940s.
Bob Geddins	Big Town Records	A record producer who recorded many of the 7th Street musicians in the 1940s & 50s.
Halena	Hotel Pines	A member of the Ladies Auxiliary of the International Brotherhood of Sleeping Car Porters.
Henry	Jimmy's Cafeteria	A member of the International Brotherhood of Sleeping Car Porters. He distributed papers from Oakland and San Francisco at cities he went to while working on the trains.
Slim Jenkins	Slim Jenkins Place	The owner of Slim Jenkins Place which was a prominent place on 7th Street
Charles "Raincoat Jones"	Sportland Recreation Hall	A prominent West Oakland figure who often wore his signature raincoat. He was also called as a "walking loan." A former bootlegger turned loan shark and dice game operator, who was known as the unofficial mayor of 7th Street and helped finance some of the jazz and blues clubs.
Saunder King	Seven Street Mission	A blues and jazz musician who made his mark on 7th Street in the 1940s.
Mr. McFarline	McFarlin's Drug Store	The owner of the popular drugstore on 7th Street and close friend with Raincoat Jones.
Pawn Shop Owner	Pawn Shop	The owner of Buy & Sell Pawn Shop that existed on 7th Street.

Gwynne Peirson	De Luxe Smoke Shop	A police officer who raided the smoke shop for running an illegal dice game in the back of the place.
Reverend	Christ Holy Sanctified Church	A reverend who spent a lot of time on 7th Street with his wife to give sermons to anyone.
Wolf Records Employee	Wolf Records	The employee worked at Wolf Records, where Bob Geddins used to work.

Table 6.1: Overview of NPCs in VWO
List of Non-Player Characters that interact with players in VWO

It was our intent from the beginning to tell the story of Seventh Street as much as possible through these NPCs. This included not only delivering the factual parts of the history of Seventh Street, but also feel or experience the literary persona of each NPC – how they talked and the particular colloquialisms they used, how they behaved. For example, the Reverend NPC (Figure 6.8) was a very neatly dressed black man wearing a black suit and a white shirt that looks like a bib. He would like to talk about the topics like religion and local politics to anyone on the street with a small bottle of whisky in his hands.

Figure 6.8 Reverend NPC

As for player characters in VWO, all players login as a same generic character with an option of personalizing their avatars (changing appearances). Those players who choose to engage in game narrative would follow similar paths of activities and the places with other players in VWO (see narrative and gameplay in VWO) as aspiring musicians.

6.5 Delivering the Content

The components that bring everything all together are the narrative and gameplay. What does the player do in VWO, and how are all those actions and interaction tied together in a larger experience of the meaning of the virtual world and the story that unravels about it? In the case of

the Seventh Street project we tried to do this by creating both individual 'quests' – small missions the player must accomplish in order to learn the history of Seventh Street, and developing an overall narrative that tied these individual quests together in some meaningful way.

While our recreation of Seventh Street as a virtual world obviously had strong elements of simulation games[5], we decided to limit the simulation to events that have actually happened on Seventh Street, but to not allow the player to make significant changes in the game world, such create characters that would not have been present on Seventh Street in the 1940s and 1950s and would look out of place to other players of the game, or they might create a music club that played modern music, not the blues and jazz of the era, which might diminish the game experience for other players.

VWO also adopted a multiplayer mode addition to a single player mode. From the beginning we had decided that our game should be multiplayer, allowing many people to log into the game at the same time and interact with each other in the virtual world. This was in part because Seventh Street was very much a social scene, and our digital game environment therefore needed to be a social experience. We allow basic social interaction among players but did not include the ability to actually change the fate of Seventh Street. Though, with single player mode, player has an option to visit VWO by himself/herself but any in-game activities would not be saved. (Figure 6.9)

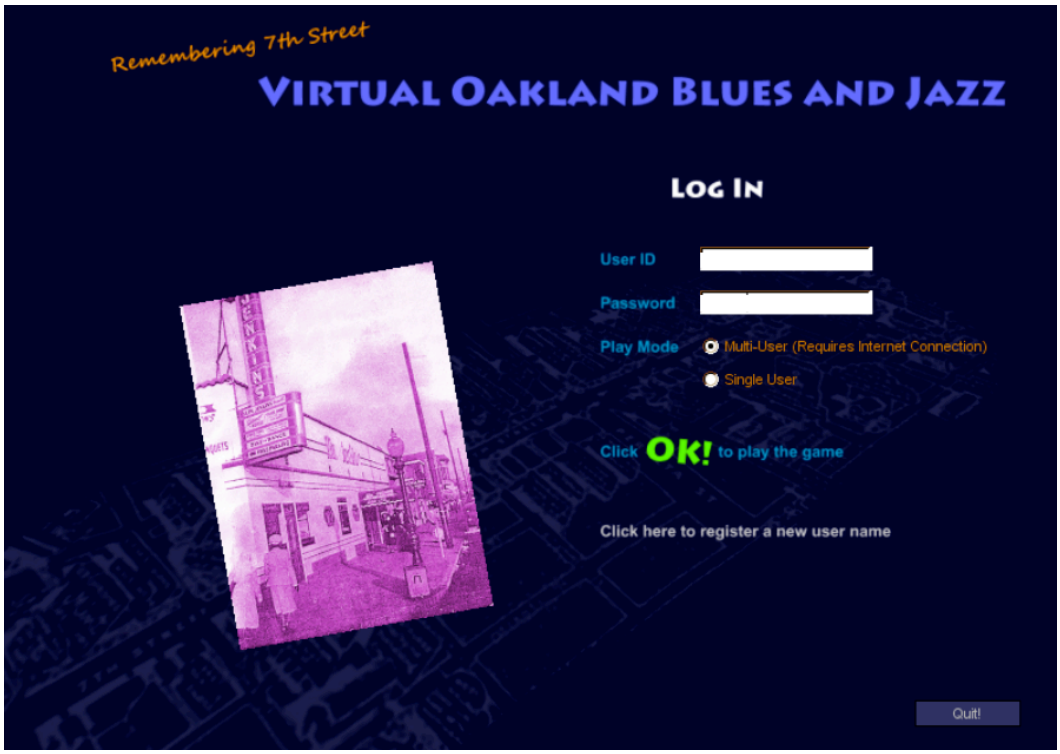

Figure 6.9 Login Page in VWO

[5] A simulation game place the layer in a situation where they are forced to make realistic decisions and can see the simulated results of their actions.

6.5.1 Entering VWO

After the player logins to the game, as an introduction, a video cut-scene tells the player a brief history of Seventh Street from 1940s to current state. It also gives the instruction to the player the general object of the initial phase of the game – to have the player what Seventh Street was like by performing at the clubs (at the Slim Jenkins Place), recorded on an album, financed by club, and distributed across the country.

When the introduction video ends, the player will be in a transitional place, Burton's Clothing Store, in the game world where he/she customized his/her avatar as wishes (Figure 6.10). When it is done, the player will exit Burton's Clothing Store and see the world of Seventh Street, West Oakland in 1950s.

Figure 6.10 At Burton's Clothing Store.
Mr. Burton NPC is greeting the player in front of his store in VWO.

The player can experience the Seventh Street in one of two ways:

- ***Exploring the VWO*** – The player can simply explore the game world, checking out the street scene, entering some of the clubs and businesses, viewing text descriptions of Seventh Street in newspapers on newspapers racks, posters on walls, etc. or interacting with and conversing with NPCs who represent the main characters of Seventh Street of the 1940s and 1950s. The interactions with NPCs has be written so that the player can simply converse with an NPC to learn about the NPC and some of the information on Seventh Street, without having to engage in game narratives.

- ***Playing the game*** – The player can choose to engage in gameplay by accomplishing the four goals of level one of the game – getting the player's music played at the clubs, recorded, financed and distributed. Game narratives involve "quests", in which the player interacts with NPCs or objects to learn about various aspects of the Seventh Street scene to accomplish each of the four goals.

6.5.2 The Four Game Narratives in VWO

As for the narrative structure, we have adopted a modular approach[6] that follows a linear progression (Figure 6.11). It requires that, for instance, Goal 1 narrative must be completed and performed in order to open up to Goal 2 narrative.

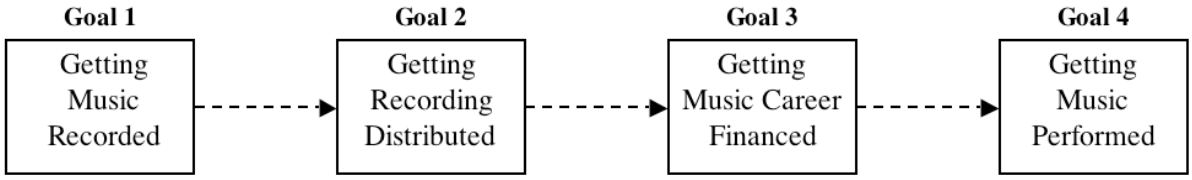

Figure 6.11 Narrative Structure in VWO.

The 4 goals and game narratives are:

- ***Getting the Player's Music Recorded.***
  At the top layer of this storyline is Bob Geddins NPC and his Big Town recording studio, the top recording studio on Seventh Street. The goal is for the player to get Bob Geddins NPC to agree to sign the player to a recording contract. To achieve this, the player must first go through a series of interactions with musicians and other objects to access Bob Geddins NPC at the top of the story pyramid and get Bob Geddins NPC to agree to record the player's music on Geddins' Big Town label. This story line also will serve the function of introducing the player to many of the most prominent musicians on Seventh Street.

- ***Getting the Player's Music Distributed.***
  At the top layer of this storyline is C. L. Dellums NPC, a top official in the International Brotherhood of Sleeping Car Porters, who served as a distribution network for 'race records' recorded by black musicians, which the porters[7] took with them and sold at railroad stops throughout the country. The goal is for the player to get Dellums NPC to agree to get one of the older sleeping car porters to agree to distribute the player's record on the rails. To achieve this, the player must first go through a series of interactions with railway and other transportation workers and union members to access Dellums NPC at

[6] In modular storytelling, the modules are objects that include both data (story) and functions or tasks performed on the story, like the passing of tokens, setting of flags, and tracking of player action (Sheldon, 2004).

[7] A porter is railroad employee assigned to assist passenger aboard a passenger train or to handle their baggage; it may be used particularly to refer to employees assigned to assisting passengers in the sleeping cars.

the top of the story pyramid and get Dellums NPC to agree to have a porter help distribute the player's record. This storyline will serve the function of introducing the player to the Brotherhood of Sleeping Car Porters, the first black Union in the United States.

- ***Getting the Player's Music Career Financed.***
  At the top layer of this storyline is Charles "Raincoat" Jones NPC, a loan Shark, gambling establishment owner, patron of the clubs and unofficial 'Mayor of Seventh Street.' The goal is for the player to get Raincoat Jones NPC to agree to finance the player's music career. To achieve this, the player must first go through a series of interactions with business owners and other objects to access Raincoat Jones NPC at the top of the story pyramid and get Raincoat Jones NPC to agree to loan the player the money to launch the player's music career. This storyline also serves the function of introducing the player to many of the business and other characters on Seventh Street.

- ***Getting the Player's Music performed at the Clubs.***
  At the top layer of the storyline is Harold 'Slim' Jenkins NPC and Slim Jenkins' Place, the most modest and popular club and restaurant on Seventh Street. The goal is for the player to get Slim Jenkins NPC to agree to let the player perform his/her music at Slim Jenkins' Place. To achieve this, the player must first through a series of interactions with other club owners, musicians and other objects to access Slim Jenkins NPC at the top of the Story pyramid and get Slim Jenkins NPC to agree to let the player perform his/her music at Slim Jenkins' Place. This storyline also will serve the function of introducing the player to the club scene on Seventh Street.

6.5.3 Gameplay in VWO

The overall structure of the gameplay in VWO is a linear sequence (Figure 6.12) with four goal structures from narrative. These goals can be achieved by the player by performing a series of quests that require tasks and interactions with NPCs or game objects.

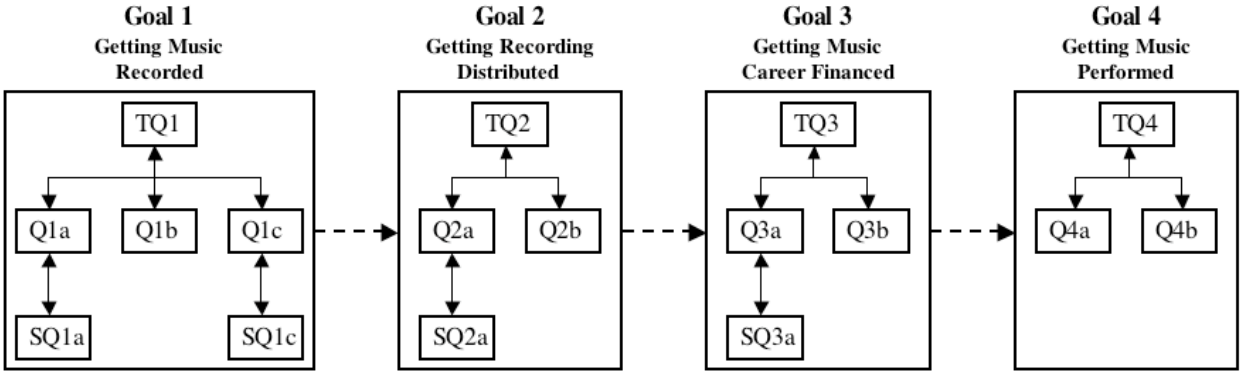

Figure 6.12 Gameplay Structure in VWO (TQ: Top Layer Quest; Q: Quest; SQ: Sub-Quest)

As Figure 6.13 illustrates, each goal is in a pyramid form, with the ultimate objective to a goal at the top of the pyramid, and the player needs to complete the tasks on a bottom third layer, in

order to access NPCs or game objects on a middle second layer, which in turn opens up the top layer of a goal to be achieved by the player. Hence, the quests that are belong to same goal module are directly related to another, with the game engine tracking what the player had accomplished, and the narrative elements of the story rewritten and presented to the player according to what had previously been accomplished. Therefore, the nature of a conversation with the musician (Saunders King NPC in Goal1) might be dependent on whether the player had already had a conversation with the preacher (The Reverend NPC in Goal1) or the record producer (Bob Geddins NPC in Goal1).

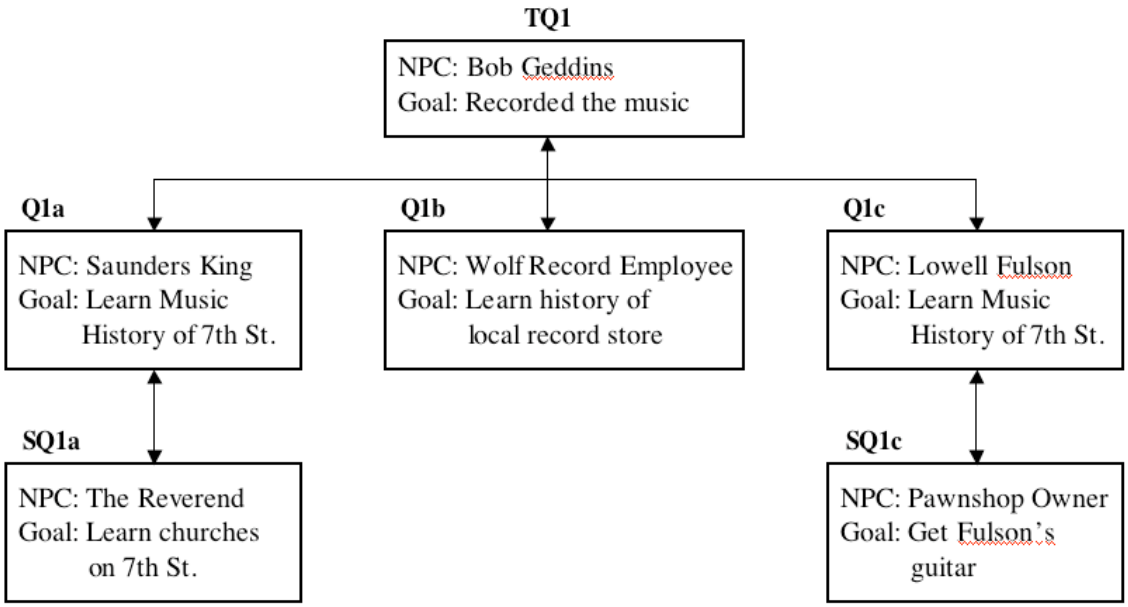

Figure 6.13 Gameplay Structure in Goal 1 (TQ: Top Layer Quest; Q: Quest; SQ: Sub-Quest)

For instance, in part of Goal 1:

- The player must get a series of tasks to perform or questions to answer from Bob Geddins NPC first, before he/she can get a next clue for the task (gameplay with the Reverened NPC) to find out from Saunders King NPC.
- If the player has not interact with Bob Geddins NPC before he/she interacts with Saunders King NPC, then Saunders King NPC will only shares his biographical information with the player, no further instruction on next gameplay.
- If the layer has interact with Bob Geddins NPC before he/she interacts with Saunders Kings NPC, then Saunders King NPC, will instruct the player on gameplay with the Reverend NPC.
- If the player has seen and completed the tasks with the Reverend NPC, and returns to see Saunders King NPC, the player can complete the quest with Saunders King NPC.

In each goal, only top-layer NPC (for example, Bob Geddins in Goal 1 from Figure 6.12) can engage the following actions with players:

- The player has not completed all of the tasks associated with this particular game narrative, in which case the top-layer NPC will direct the player to the tasks that need to be completed within this game narrative.
- The player has completed all tasks associated with this particular game narrative, but has not completed all the other game narrative, in which case the top-layer NPC will direct the player toward completing the other narratives.

The dialogue in the quest between the player and the NPC is a simple and essentially linear sequence with questions and answers (Figure 6.13). The questions and answers are sequential – that is the first question appears, followed by the NPC's answer, which then causes the next question to appear, followed by the NPC's answer, and so on. The player cannot choose the order in which the questions are asked. At any point in the question and answer sequence, the player has the option of breaking off the conversation and interaction.

Player: Do you know Bob Geddins?
Fulson: That's the guy I told you recorded my first record. I'll never forget that day when I wandered into his shop. There was an old beat up guitar in the corner and I asked Bob if I could play it. After I hit out a song, he asked me who I recorded for.
Nobody, I said, and he signed me right then. It was Bob who taught me how to phrase the blues. You'd be surprised by what a man that doesn't sing can tell you about how to sing a song. He wrote my first big hit, "Three O'Clock Bules."
Player: Do you still have that guitar?
Fulson: I heard that old beat-up white guitar got pawned to the Buy & Sell store. Musicians down on their luck are always pawning their instruments there. If you can find my guitar, come back and see me.

Figure 6.14 Sample dialogue between a player and a NPC (Lowell Fulson, in this case).

Here is the complete list of quests are designed for VWO.

Quest	Quest Layer	Quests or Conditions Required to Access
Goal 1. Getting Music Recorded		
Bob Geddins	Top	*Goal:* Getting Music Recorded *Conditions:* A practice session at Slim Jenkins Place Completion of other Goal 1 Quests *Item*[8]*:* A record
Saunders King	Q1a	*Goal:* Learn about a local musician *Conditions:* Engaged in gameplay with Geddins & the Reverend

[8] Some of the quests are required to collect or to exchange the items that allow gameplay to continue. All items are stored in player's inventory.

The Reverend	SQ1a	*Goal:* Learn churches *Conditions:* Engaged in gameplay with King
Wolf Record Employee	Q1b	*Goal:* Learn history of famous local record store *Conditions:* Engaged in gameplay with Geddins
Lowell Fulson	Q1c	*Goal:* Learn about a local musician Find a white acoustic guitar *Conditions:* Engaged in gameplay with Geddins Been to the pawnshop *Item:* White acoustic guitar
Pawnshop Owner	SQ1c	*Goal:* Get Fulson's guitar *Conditions:* Engaged in gameplay with Fulson *Item:* White acoustic guitar
Goal 2. Getting Recording Distributed		
C. L. Dellums	Top	*Goal:* Getting Recording Distributed *Conditions:* Completion of Goal 1 Completion of other Goal 2 Quests
Halena	Q2a	*Goal:* Learn black community papers in Oakland *Conditions:* Engaged in gameplay with Dellums & Henry *Item:* A tack of local newspapers
Henry	SQ2a	*Goal:* Learn about Pullman Company *Conditions:* Engaged in gameplay with Dellums & Halena Deliver the community papers to Henry *Item:* A tack of local newspapers
Jewel Brown	Q2b	*Goal:* Learn about Pullman Porter *Conditions:* Engaged in gameplay with Dellums Finding two caps *Item:* Red and dark blue caps
Goal 3. Getting Music Career Financed		
Raincoat Jones	Top	*Goal:* Getting Music Career Financed *Conditions:* Completion of Goal 1 & 2 Completion of other Goal 3 Quests *Item:* Money
Lincoln Theater	Q3a	*Goal:* Learn about a local theater
Tom Bowden	SQ3a	*Goal:* Learn about a local performer *Conditions:* Engaged in gameplay with Raincoat Jones Visited the Lincoln Theater
O. C. McFarlin	Q3b	*Goal:* Learn about the popular drugstore on 7th street *Conditions:* Engaged in gameplay with Raincoat Jones
Goal 4. Getting Music Performed		
Slim Jenkins	Top	*Goal:* Getting Music Performed *Conditions:* Completion of Goal 1, 2 &3

		Completion of other Goal 4 Quests
Gwynne Pierson	Q4a	*Goal:* Learn about local smoke shop *Conditions:* Engaged in gameplay with Jenkins
Bartender	Q4b	*Goal:* Learn about history of local clubs *Conditions:* Engaged in gameplay with Jenkins *Item:* A newspaper clipping

Table 6.2 List of Quests in VWO (TQ: Top Layer Quest; Q: Quest; SQ: Sub-Quest)

6.5.4 Other Game Features

1) VWO Map

As discussed in chapter 5, a game's feedback provides the player with all of the information necessary to make the player's choices meaningful. For example the most basic information a player needs is the status of his or her own position in the game world. As Figure 6.14 shows, the map shows a current location of player in VWO and also shows some of the places that important to player for the gameplay.

Figure 6.15 Player Position in VWO.

2) Quest Log

It is important to provide information on the player's current goal and the player's status toward achieving it, because it informs the players about their progress through the game. Not all of this information needs to be prominently displayed, but it should all be made available to the player.

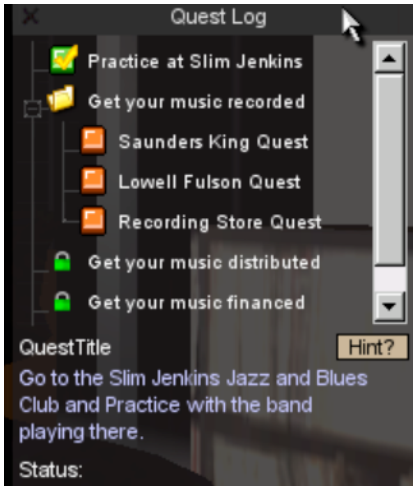

Figure 6.16 Quest Log in VWO

Quest Log (Figure 6.15) can be accessed by pressing the icon  in the interface. The log is useful in keeping track of the quests that have been taken, the tasks necessary to finish them and completed quests. Also a one line of "Hint" to the Quest Log that can help the player who needs more information on the next activity player has to do.

3) Inventory

Inventory system (Figure 6.16) shows the status of items or objects that player has picked up for the part the gameplay: player can check his/her Inventory by clicking (a) to see the items that his/her have collected. (b) Highlighting the item and (c) click "Look" to see the detail of it.

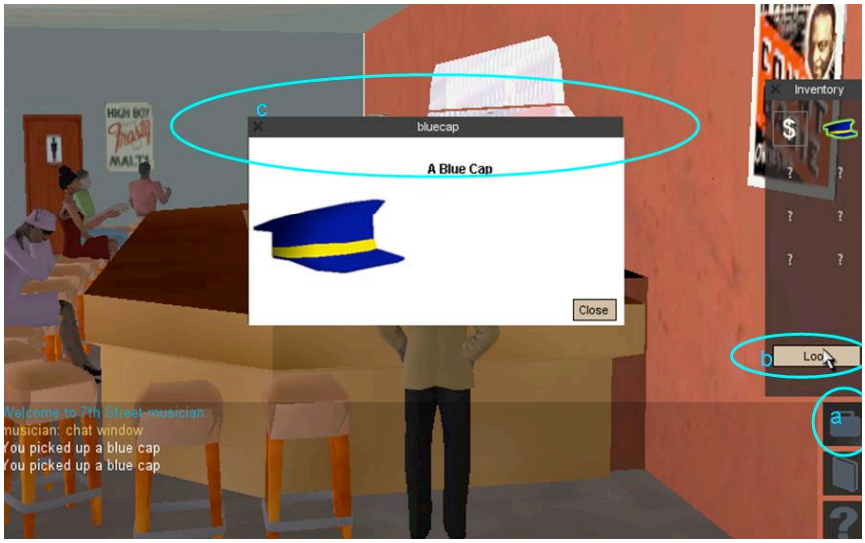

Figure 6.17 Inventory in VWO

6.6 Pilot Study

The goal of the pilot study was to answer the following questions:

- Does the game pose an interesting and adequate *challenge* (the players' experience of their ability relative to the game) to the intended target group of players (Marlone, 1982; Prensky, 2002)? Not too difficult, nor too easy? And is the challenge to be found in the game content, rather than in the game controls? What do players understand and what confuses them?
- Finding out whether an application is fun, or not, is only part of the answer, more important is how did the different elements in the application contribute to the experience (Marlone, 1982)? Is the game *engaging (capturing the player's attention)* for the players?
- How does the (social) *interaction* develop? Which elements in the application support social interaction, or which interfere with it?
- Does VWO capture the interest of player? Would participants continue to play the VWO game if they had more time? What *motivates* the participants to play?

The pilot study utilized a mixed methods data collection strategy with the following methods:

- ***Completion.*** Measured the adequate challenges for the participant to complete the tasks of the game.
- ***Gameplay Observations.*** Observed how the participants were faring with the game. The observations include: how engaged participants were while playing the game, and how much social interaction occurred during the time the game was being played.
- ***Thinking Aloud Method.*** The participants were asked to verbalize their thought process while they played the game. By verbalizing their thoughts, participants allow the observer to determine not just what they were doing with the game, but also why they were doing it.
- ***pre-and-post Questionnaire.*** Measured how much information or understanding has been gained after playing the game.
- ***Interviews.*** Participants were interviewed as a group by the facilitators immediately after they played the game. These interviews collected participant's general impressions of the game and their specific impressions about major game components.

6.6.1 Participants and Procedure

A group of ten tenth-grade and eleventh-grade students (seven males and three females) were recruited to participate in the pilot study. Participants' ages ranged from fifteen to seventeen years old. All participants were volunteers.

In the beginning of the pilot study, all participants were asked to answer the personal background questionnaire, including: age, sex, amount of computer usage for studying, amount of time they spend playing digital game during a typical week, and a list of digital games that they played. From these questionnaires, all participants, except one, identified as digital game players and experienced with different genres of digital games. All participants, except two, had experiences of playing multiplayer games prior to the pilot study. None had prior knowledge of West Oakland before this pilot study.

After the questionnaires, we gave the participants a brief description and introduction to our project and a short demonstration of VWO operation was presented to the participants. Then the participants spent a brief period of time being made familiar with user interface and basic controls of VWO. Participants were asked to play for up to 30 minutes, until they completed the given game tasks, or until they wanted to stop. We asked participants to think aloud during task performance and researchers observed how participants interacted with the game, how engaged students were while playing the game, and how much social interaction occurred during the time the game was being played. After completion of the game, the participants were asked to complete the post questionnaires, then as a group, we asked the participants for any comments or additional feedback about the VWO, reflecting on their experience, and what changes or additions they would like to see.

6.6.2 Discussion of Results

The following findings regarding the design of the game are based on the student feedbacks and the observations during the game phase. The results are organized into five parts: Completion, Challenge, Engagement, Social Interaction, and Motivation.

1) Completion

Within 30 minutes of game time, 80% of participants completed the game tasks. All participants, who completed the game tasks, stayed on for further exploration of the game until 30 minutes of game time concluded.

2) Challenge

Does the game pose an interesting and adequate challenge (the players' experience of their ability relative to the game) to the intended target group of players (Marlone, 1982; Prensky, 2002)? Not too difficult, nor too easy? And is the challenge to be found in the game content, rather than in the game controls? What do players understand and what confuses them?

All players found the basic keyboard/mouse control for the game was easy to use, but 40% of participants also suggested for allowing the arrow keys to navigate VWO. Also, the participants recommended to finding a simpler solution for interacting with NPC. Instead of changing PC from shoulder view (third person's view) to first person view to interact with NPC, the participants suggested a simple mouse click interaction would be desirable.

We asked the participants whether the game story was easy to follow, and 40% of them responded as yes, 50% of them responded as somewhat, and 10% of them responded as no. Also, for the question of how often the participants felt confused or disoriented during the gameplay, 30% of the them responded as rarely, and 70% of them responded as sometimes. The participants explained these responses during the group interview session and narrowed down to two issues: 1) challenging to find the interactive NPC or place, and 2) need for the same linear narrative storyline for all players in the multiple players setting. During the gameplay observations, some of the participants got often lost, or traveled "off route" even though the participants often used the location map to find the some of the place or NPC that was important to player for the gameplay. As for the game narrative, the participants commented that game story was not hard to understand or to follow. However, because of linear narrative structure of the game: 1) all participants must start at the same place and to follow the same storyline that it caused the

disruption of game flow as they must wait their turn to complete the game quests, 2) if the player missed or did not follow the sequence of the quests, it was hard for them to recover their mistakes, and 3) the participants suggested that game narrative needs more conflicts than simply collecting the information about the VWO through NPCs.

3) Engagement

Finding out whether an application is fun, or not, is only part of the answer, more important is how did the different elements in the application contribute to the experience (Marlone, 1982)? Is the game engaging (capturing the player's attention) for the players?

In the post questionnaire, we asked the participants whether the game was interesting or fun. 70% of participants responded that the game was somewhat interesting or fun, and 30% of participants responded with yes. All participants expressed positive responses toward the recreation of VWO, as 70% of the participants responded that the realistic visual rich environment of VWO impressed them most when visiting VWO, and helped to create the immersive experience for the participants. Sixty percent of the participants also said they were impressed with the interaction with both NPC and PC in VWO. However, 50% of participants responded the linear narrative progression of VWO made the game experience less interesting. For instance, "It seemed a bit too simple and kind of linear that all you can do is what the game gives you. You cannot go off the main storyline" (Participant 1). "Having multiple quests in different areas would help so that everyone is not bunched together in one area waiting to talk to an NPC." (Participant 3).

Also, we asked the participants which elements contributed most to participants' experiences in VWO. They responded that all four elements, controlling the action of PC, exploring the environment, hearing sounds of VE, and being in the company of other visitors, were equally contributed the experience of VWO.

4) Social Interaction

How does the (social) interaction develop? Which elements in the application support social interaction, or which interfere with it?

Being in the same physical environment largely influenced the participant's interaction with others. When the participants spent a brief period of time being made familiar with user interface and basic controls of VWO, all participants were trying to figure out where their peers were in VWO by calling their names and asking them questions in physical environment setting, not communicating through the dialogue box that was provided in VWO. During the gameplay, when some of the participants faced the problem, they physically walked up to other participants to ask for help. Additionally, almost all participants, except one, chatted with other participants at least more than once in physical environment while they were playing the game. During the group interview session, the participants explained that since they were all in the same room for the gameplay, it was easier to communicate with others by directly talking to them then typing on dialogue box in VWO. They also mentioned that listening other's conversation in physical environment influenced the way they played the game.

In the post questionnaire, we asked the participants to select all elements from the list that influenced their behaviors during the game, and the results were in following (in the order of most influenced to least influenced): VWO environment (80%), other PC's presence in VWO and other participants' behavior in the room (70%), NPC (60%), other PC's behavior in VW (40%), and other participant's physical presence in the room (20%). During the group interview session, some of the participants asked to have more conversation options with other PCs. Also, they suggested that it needs competitive challenges among players or cooperative/shared tasks to interact with other players to have a better experience the VWO.

5) Motivation

Does VWO capture the interest of player? Would participants continue to play the VWO game if they had more time? What motivates the participants to play?

We asked the participants in our post questionnaire what they learned about VWO after playing the game, and 70% of the participants responded that they learned about the blues and jazz music culture. Thirty percent of the participants expressed that they learned about the street characters, like the Reverend, and historical elements of street, like the types of transportation and style of buildings that exist in VWO. During the group interview, most of the participants expressed the desire to know more about the history and cultural life of West Oakland and why the place no longer exists. They also mentioned finding a better way to interact with NPCs. They suggested that NPCs could be acting more than giving the puzzle but acting as collaborators in the pursuit of solving the puzzle.

In the post questionnaire, 60% of participants expressed that they would be interested to come back on their own times and play the game again. In response to any features that would like to see or would consider necessary to have for VWO, a better control of their own PC and a character customization option were the top of the list followed by more option to complete the quests, more control of objects in VWO, and more option of choosing different characters in VWO.

6.6.3 What We Have Learned

From observations and interviews, we learned:

- *Narrative and Gameplay:* Students were interested in cultural history of VWO but suggested that more conflict would evoke greater curiosity. Recommendations included developing conflicts between characters and even misleading storylines, and the conditions that player can compete. Students also focused on the narrative structure, recommending that game narrative should not be too simple or linear. They did not like everyone started and followed the same game narrative that led most players to wait their turns for same Non-Player Character to completing their quests. Students also suggested that some of the storylines should be intersected among the Player Characters so that would increase more interaction with other Player Characters. Students also suggested that the VWO needs other things to do than the quests.

- *Player Characters (PC):* Students suggested the avatar customization to allow the players more than deciding how their PCs are going to look. Students expressed interest in being

able to design their own characters may allow students to better identify with the character. Also, they wanted to have different characters to pursue with different learning goals and activities.

- *Non-Player Character (NPC):* Students liked the VWO was populated with bots even though there were no direct interaction with them. Students liked the interactions with NPCs and remembered the NPCs most with unique or unexpected personalities, like the Reverend with a whisky bottle in his hand. Students suggested NPCs could be, perhaps, as active collaborators in the pursuit of solving the puzzle.

- Game Environment: Students liked the authenticity of VWO to experience and to feel the streets through various objects, such as tramps.

In addition, students rarely used the universal chat function to ask for help. They preferred they 'could walk up and talk person-to-person.'

Students indicated that their behaviors were largely influenced by 1) the visual environment of game world; 2) presence of other users in the game; and 3) other users' behaviors in the room.

Chapter 7 Discussion

7.1 Designing Learner's Experience

Although modern tools of information and game technology provide excellent opportunities for creating potentially great learning environments, the research of MOG as a learning environment is still in its infancy and it has been a great challenge for us to develop our VWO environment for learning. Developing VWO was a constant struggle between various design constraints, balancing between authenticity, providing a 'fun' and 'learning' environment for learners.

In VWO, as the nature of digital game, learners have been given the opportunity to gain knowledge through first hand experience in the virtual world. It allows learners to participate in the game world, inhabit roles that would otherwise the inaccessible to them. The environment is immersive in ways that makes learner's feel "inside" an environment with authentic contexts and activities that learning the history and culture through meeting NPCs, who were real characters in lived on Seventh Street, or having the opportunity to participate in some of the activities that happened at that historical time. These kinds of experiences can be a powerful pedagogy that allows the learner to be immersed in extended experience with problem and contexts similar to the real world.

There were many elements that impacted the design of VWO and it was important to understand how each design element of game works together to build the whole experience for player. What was critical that creating "convincing" content was not only with visual rich environment that we tried to provide, but was impacted by most with what does the player do in VWO, and how are all those actions and interaction tied together in a larger learning experience through narrative, gameplay, and NPCs.

7.1.1 Player Character (PC)

As for the player character in VWO, all players login as a same character with an option of personalizing their avatar (changing appearances). Those players who choose to engage in game narrative would follow similar paths of activities and the places with other players in VWO as aspiring musicians. This resulted the players from pilot study to feel the game narrative is linear as single player game, and also expressed more control of their own characters in VWO.

One way to improve is to analyze the perspective of the narrative and thematic aspects of games. It is better when players can identify with particular characters and their identities. The character is a reflection of every action a player has taken in the digital game environment, similar to an existential self-portrait. Not surprisingly, players are emotionally invested in the statistical profiles of these characters, far more so, than they would be in a simple score tally. Players like to experience the ways a particular character thinks about and solves problems – as a street musician who wants a record deal, an activist who wants to protect the area from disaster of urban renewal, and so on. In this way, the game can provide "distributed authentic character."

Designing a dynamic character who grows or progress to higher level of understanding in the course of the story was another challenge to VWO. His/her character might improve status and or gain new equipment and levels that help him/her deal with bigger and tougher challenges. In a

linear narrative game environment, it can be assumed that the player's skills are also increasing over time and that the player will need tougher challenges the longer he plays. This also helps to provide some new challenges and continually interesting new things for players to find and over come. In a nonlinear narrative game environment, it can be very difficult to control where players go. If a player is allowed to freely roam through the entire world, it is impossible to balance the difficulty of the game. What keeps a player from running from the start of the game to end of the game without stopping, even accidentally?

7.1.2 Non-Player Character (NPC)

In VWO, the NPCs have been used in many ways. NPC were characters in a generated story and also as part of the solution to a puzzle. NPCs delivered the parts of the history of Seventh Street through their personal stories. Also, NPCs delivered the instruction the quests that player need to solve within game environment. Additionally, NPCs were populated on Seventh Street as part of the 'context' that even limited or no interaction with them, players could still learn some of the activities and opportunities that occur in the game world by observation.

From the pilot study, there were two interesting comments about NPCs in VWO. One of them was that players liked and remembered the NPCs most with unique or unexpected personalities. Partially, it was easy to identify the unique NPC from the rest, but also the unique NPC could motivate the players to learn more things about the NPC by raising a question like, why did the Reverend have a whisky bottle in his hand? He was different from the other NPCs the player has met and might have unique goals, and the player cared about this NPC because his goals interested that player. It showed the breaking social stereotypes can be intriguing for the player. If the player takes no action, the NPC might prevail to get player's attention.

Another comment from pilot study was student's interest to collaborate with NPCs in the pursuit of solving puzzle. This reflected the player's desire to have better social interaction with NPC. To improve this interaction, some of the interests of the NPC should intersect with player character. The more the goals an NPC and the PCs have which intersect, the more interested the players will be in that NPC. Goals can intersect in a variety of ways. If the PCs have some type of *affect* on the NPC, there would be a natural intersection taking place through this influence. Perhaps the PCs and the NPCs are competing groups attempting to investigate how different urban development changes the Seventh Street. Though, the NPCs actions and motivations must make sense in the context of the world. NPCs should not randomly change their motivations or goals and game narrative.

Another way to improve the interaction between the NPC and the PC would be when NPC can deliver instruction/guidance based on the learner's context such as geographical location (e.g., Lincoln Theater) and current knowledge of a particular subject. NPC should balance the roles with PC. NPC could make sure PCs needs (for information, for moral support, or for guidance) are being met; fill in gaps as necessary. Sometimes, NPCs can seem arbitrary or clunky if there is not enough of a social world in the game to support them.

7.1.3 Narrative and Gameplay

The most challenging part of the design in VWO was how to bring different components of digital game learning environment together to give a player meaningful learning experiences: What does the player do in VWO, and how are all those actions and interactions tied together in a larger experience of the meaning of the virtual world and the story that unravels about it? To design the meaningful learning experience and activities, narrative and gameplay played the major roles and also became the most strenuous components to design.

Even though our intention of VWO had been a multiplayer platform which supports enable communication and create social spaces for both NPCs and players, our overall narrative and gameplay structure for VWO developed to be more linear. As a result, the player can complete the game quests by only interaction with NPCs, without any input from other players, and the results from case study showed a need of better interaction among players through narrative and gameplay.

This raised two questions. The first is, "what makes designing a multiplayer structure difficult?" The second is, "how much players are allowed to control over the outcome of each play?"

1) What Makes Multiplayer

One of the toughest parts of designing games is trying to anticipate everything that the user might want to do. Every puzzle must have a solution. A puzzle is any kind of problem that you represent to the player. A puzzle can be very broad. Just creating a room with an entrance door, an exit door, and enemies in between creates a puzzle. The player must figure out how to safely get through the room. The more variables are available, the more possible solutions can occur. The design challenge is to anticipate what the player might try and do and then make sure that none of the solutions ruins the game.

A major advantage of designing for a single-player experience is that it gives the designer more control over what happens to the player. In single-player game, both narrative and gameplay are designed for a player who can enjoy the game without input from other people. There are no other players are involved whose input may cause unpredictable outcomes, or whose input can counter the themes and moods the designer is going for. Also, it only needs a limited number of possible solutions for each puzzle to provide for the player. It is easier for the designer to check for certain player acts or events to occur and can be certain that they have been trigged and experienced by the same person, while this cannot always be easily determined in a multiplayer context.

One of the misconceptions about designing multiplayer game is probably that a multiplayer game is almost a larger version of single-player game. Multiplayer game means any game where more than one player is involved in some form of competitive play, or non-competitive, interactive play addition to individual quests. Sometimes it is fun to help each other and tackle challenges together. It can be fun to solve a mystery with a friend, or compete each other as adversaries or opponents. However, as it mentioned above, somewhat unpredictable outcomes in multiplayer game make difficult for the designer to control over the content of the game or how to structure the multiple solutions that affect more than one player.

These factors influenced some of our design decisions on narrative and gameplay structure in VWO. Our modular approach to narrative and gameplay might have provided us better control of overall storyline and gameplay, and less complicated the storytelling with a few solutions for each puzzle. However, even though being or seeing other people in the same environment is a great platform for possible social activities, this does not mean that player would feel a part of community (engagement), be able to reflect on their roles and context within the community (imagination), and be able to negotiate these roles within the community so they can work collaboratively as a community and game more than if they were operating individually (alignment).

If player's learning activities are not required the other player's involvement in the environment, then what would be the point of having a multiplayer platform? An activity can be started from an individual perspective but the learner should be directed to complete the activity collaboratively. When participating in a learning event in the multiplayer environment, learners are already 'present' as a community of avatars, and commence the activity together. By working as a community, they are better motivated to learn, mutually engaged and can form a working-group.

Therefore, the quests should be designed in such way that they can be able to be completed by (a) individual characters, (b) groups of individual's characters, (c) collections of characters, and (d) groups of collections (multi group quests). Different types of encounters, encouraging interactions between small and large groups of players, and multiple routes to objectives should be encouraged in multiplayer platform. In team pursuit, it is important to provide incentives for players to adapt their behavior and collaborate.

One way to approach this is that VWO narrative should be bit more dynamic and with a life of its own. The key is that it has the capacity to change over time in response to the activities of the player, and their future trajectory is not predetermined. This allows players to have a genuine sense of involvement in the evolution of the game. For example, a particular location might become damaged with a noxious urban developer, making some of favorite spots of Seventh Street in VWO more vulnerable. Only by sustained effort can the destruction be removed.

The approach can provide a story-like situation that can be resolved in the shared public world in a way that involves multiple players. It draws on the inherent strengths of multiplayer (e.g., persistence and shared social world) and computer games in general (e.g., openness outcome). Unlike standard stories, players really can share the outcome, and if structured correctly, the unfolding history of action in the game takes on a distinctly narrative form.

2) Nonlinear Way

In VWO, as it can be seen in most linear games, players were told exactly what to do, such as picking up an item and bring it back, limit the range of user interaction with NPCs. As a result, players from the pilot study felt less control of the game environment and they wanted to have more choices in gameplay.

The goal of nonlinearity was to provide players with many more choices. However, telling a good story in a nonlinear game is very difficult. Players do not travel in a string path, it is

difficult to predict where they will go and in which order; as a result, it is difficult to script a nonlinear story, and it is more challenging in the multiplayer platform.
Although, it is nearly impossible to design in multiple solutions for every puzzle but the player should feel the most satisfied when they come up with what they think is an ingenious solution to a problem and it works. Also, understanding that, in many cases, the storytelling or control of the plot rests in the hands and skills of the player. The designer's job is to give numerous paths and options for the player to operate therein. For instance, eating and then riding three roller coasters at an amusement park may produce a much different result (stomach wise) than riding the roller coaster first and then eating a big meal.

The designer sets the stage and provides paths and possible storylines. For each path, an outcome is determined. Some areas can be entered only once, while others can be entered multiple times. Some areas must be entered in a specific order, and in others, the order produces different outcomes. Some area is like a sandbox where has open-ended for players to be more creative.

To construct the nonlinear environment, there are the countless what-ifs as we create the plot and the locations, determine the sequence of events, decide how those events will play out, and pick the one ending that feels right out of all the possible endings. In order to empower the player, a game needs to make them all available as options that the player has to: 1) discover, 2) choose to act upon (or not), 3) choose how to act upon them, and 4) carry out the action (which could succeed or fail).

7.2 Designing Assessment

What we have not succeeded to implement in VWO was a formal assessment. It is important to identify and develop tools to measure student learning. With VWO, like other games, we only provided the player's progress in the game but did not provide the formal assessment of learning. So, instead of automatically giving a check mark in the player's inventory whenever the player completes the quest, digital game learning environments need some method of checking if the player actually understands enough to move on to the next tasks. One suggestion might be to have a self-assessment quiz embedded into the each quest to determine the knowledge that players have gained after completing that specific quest just performed. Another suggestion is to make more connections between quests in such way that when the player has gain the knowledge from quest A, quest B should give the player the opportunity to use the knowledge from quest A to finish the quest B. It would be important that players can only advance to higher levels by testing a range of strategies and applying the knowledge that they have gained from previous experience.

Digital game environments emphasize learning in action. They help learners understand phenomena by working with them from the start in complex situations rather than by first mastering isolated facts and skills and later assembling these conceptual building blocks to solve more elaborate, more complete, more realistic, and more sophisticated problems. In such environments, mastery of basic facts and skills are not an effective measure of expertise. Therefore, useful and meaningful assessment needs to focus on performance in context rather than on tests of abstracted and isolated skills and knowledge.

In use, formative assessment would be experienced as part of the game, providing hidden modulation of the challenges related to the academic material and cognitive demands that are necessary for sustained play. The information about how students are doing during the game needs to be provided to the teacher or the students themselves and ideally throughout gameplay. We can capture this process data through evaluation of students' online clickstream behavior to support inferences about students' ongoing understanding. The use of performance and process information, by the student or the teacher, with the intent to improve learning underlines the idea of formative assessment (Black & Wiliam, 1998; National Research Council, 2001, 2003).

This may be one of the biggest potentials for digital game learning environment design – the ability of process data to help explain learning outcomes (e.g., use of productive or unproductive strategies), sense and adapt to students' evolving understanding of the domain, misconceptions, or gaps in domain knowledge. However, while it would be a good idea to make assessments that do not disturb the flow of gameplay, the current digital game technology still faces the technical limitations of applying these assessment capabilities.

In order for digital games to be effective in an educational context, identifying the range of learning outcomes of interest and decision should be made in early stage of design. Whether it is captured and how the game responds to the behaviors must be systematically chosen to align with the learning objectives of the game and the purposes it will serve. The difficulty here is to meld this game architecture with the instructional learning system as well as to assure that various scenarios to which the player is exposed provide comparable or comprehensive attention to the performance expectations. Unless these elements are tentatively structured at the front-end, there is little hope that the game design (e.g., the game's rules, response expectations of the players, or narrative) will support the types of learning to be experienced or the framework for their evaluation (Baker & Delacruz, 2008).

Chapter 8: Discussion

8.1 Conclusion

The notion of using digital games for learning causes some to cringe, others to leap for joy, and many to ask questions about this learning medium. These questions often come from people and organizations that are considering delving into the world of learning games but do not know if this is advisable or do not know where to start. The goal of this dissertation was to answer some of those questions about multiplayer digital learning games and to help plot a path for people and organizations interested in developing or fostering the development of multiplayer digital games for learning.

The challenge is to design and develop multiplayer digital games learning environments that simultaneously created an enjoyable experience for the player as the player develops or improves his or her skill or knowledge set as a result of gameplay and applies these newly developed skills or knowledge to similar setting. A multiplayer game format could provide the motivation that learners need to learn and at the same time, enhance both the achievement and the social interactions of the learners. The task of understanding the multiple aspects of learning environment and then attempting to develop a new multiplayer digital learning environment is a complex undertaking. In order to design multiplayer digital learning games, we must understand what motivates learners to play digital games, how to incorporate educational content into digital games, and how to develop appropriate multiplayer educational tasks.

Technical limitations still greatly exist to develop and implement for learning but it is critical that designers develop innovative models of learning environments as well as methods, processes, and tools that effectively use for our future generation.

In order to significantly enhance the digital learning educational experience for future generations of students, this digital game technology must be effectively and intelligently used for learning materials that are: 1) interactive in the sense of context-sensitive responses to the learners actions, 2) nonlinear so that learners can determine their own learning path, 3) multiplayer format to encourage the community of learning; and 4) actively engage learners of different levels of base knowledge.

8.2 Future Research Directions

The development of multiplayer digital learning game is not an easy task considering the complexity of many different components from various design fields, that they all contributes creating learning experiences for the players. Still it needs many things to be considered and be implemented, and be tested for better results. Future research directions include the following:

(a) Understanding how game narrative and gameplay contribute to motivation and learning.

(b) Researching on nonlinear narratives, including techniques for sequencing plot elements into coherent, interesting stories and directing characters' actions to achieve educational objectives.

(c) Researching on how game can be use to support learning in formal learning environments.

(d) Developing the assessment models for digital game learning environment.

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