DESIGN AND DEVELOPMENT OF SIMULATION/GAME SOFTWARE: IMPLICATIONS FOR HIGHER EDUCATION

by

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Abstract

Online education is not yet utilizing the interactive potential of computer technology. In the future, higher education faculty may collaborate with commercial game designers to develop simulation/game software. This study analyzes the potential for disjunctions between these two groups of designers.

Twenty-two designers of home entertainment computer games were surveyed and interviewed about the prospect of simulation/game software to be developed for use in online education. Specifically, their perspectives were probed with respect to three dimensions: a) designing for open exploration of a specific closure (winners and losers), b) relative commitment to objective or subjective representations of knowledge, and c) preference for pre-planning or a tolerance of the iterative nature of software development. The survey results indicated a preference of game designers to design for a specific closure (with a final determination of winners and losers) rather than an open exploration. A high commitment to representing objective knowledge was also indicated. Interview responses indicated a high tolerance for the iterative nature of software development. The analysis emphasized a disjunction/overlap of an academic culture that elevates critical thinking and a consumer entertainment culture that elevates curiosity. The use of computer simulation games may be most supportive of learning, in a culture than elevates the curiosity above critical thinking, and thus better serve the democratization of knowledge where ‘everyone is invited to the knowledge party’. Such an implementation would be a divergence from the typical approach in higher education, where knowledge-participants are required to join a ‘members-only’ club. Future researchers may wish to profile the curiosity of learners and specifically design for this dimension.
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Acknowledgements

I regard this text as a scholarly dialog, between myself and the three committee members... but what an odd conversation. I say 20,000 words. Roger Boshier insists I say another 10,000 words. I restate my 30,000 words. Roger insists I include another few thousand words and add some diagrams. Hans Schuetze suggests my discussion might profit from a more explicit relationship between simulations/games and learning theory, especially ‘situated learning’ and ‘action regulation theory’. Peter Nemetz diplomatically invites me to include another 100 citations. It’s been a privilege and an honour—I owe you all a debt of gratitude. I await with eagerness the comments of the external examiner, Mary Bryson.

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CHAPTER 1

STEALTH LEARNING WITH COMPUTER SIMULATION/GAMES

In 1989, I played my first computer simulation game. It was the most compelling learning experience of my life. The game was *Hidden Agenda*, and I became President of a Latin American country who chose to form a coalition government, feed poor people and bring democracy to citizens. Winning the game was possible only by staying in power for three years and avoiding a military coup. However, no matter what strategy I chose, in order to win the game I always ended up in debt to the International Monetary Fund. This game situation paralleled the reality of Latin American countries in the 1980s. After playing the game I read several books about U.S. foreign policy. Thus I came to understand these countries were different from my own. I also made life decisions based on my learning experience. In 1995, I chose not to invest retirement funds in pro-Mexican free trade mutual funds and thus avoided the catastrophic devaluation of the Mexican currency. Had I not played this game, I might have been easily misled by hyperbole surrounding the Free Trade debate. Of relevant interest is a report from the game designer that *Hidden Agenda* continues to be used in the United States (at a State Department office in Arlington, Virginia) to provide training for drug enforcement officers, as well as agents for the Central Intelligence Agency and Federal Bureau of Investigation (Gasperini, 2000). While this product was marketed as an entertainment product, it was intentionally designed for instructional purposes.

I have since played other games and derived similar benefits—introduced to a variety of topics that I would not have had time to pursue through conventional instruction. As a result of playing these games I am now interested in topics that include economics, sociology, foreign policy and urban planning. I peruse the everyday sources of news looking to further my awareness. Ultimately, I would like to design a simulation authoring software tool but the first step was to understand if computer games could/should be used in formal educational environments. These tools provide
compelling learning. They seem to present a unique strategy for constructing understanding. Why had I not encountered them before? What opportunities existed for these games to be implemented in higher education?

A subsequent review of literature answered the questions—simulation games have been used extensively by individual teachers. Now there is an opportunity to use games on-line. I had not encountered these games before because they have not been widely adopted by many teachers. Instead games tend to be used only by teachers who developed them and sometimes a small cadre of followers. In general, this type of instruction is not compatible with conventional classroom practice. However it has been used extensively in a workshop seminar format for the training of management executives. My hope is that if these games can be more widely distributed through on-line education, then all levels of society will have access to a learning opportunity currently only available to elite decision-makers.

In this study, respondents used unusual adjectives to refer to the kind of learning required of and supported for the end-user. “Sneaky learning”, “learning-by-accident”, “under-the-radar-learning”—my favourite adjective was “stealth” learning. In the literature, this kind of learning is usually recognized as informal learning. However the word “stealth” is an intriguing choice. It is defined as “going or passing furtively, secretly or imperceptibly” and implies “sneaking up on the enemy”. Simulation/games do offer a kind of empowerment—an access point into understanding the complexity of the modern world. Is complexity the enemy?

**Purpose**

The purpose of this study was to identify the design perspectives of simulation/game designers working in the home entertainment market and analyze for possible disjunctions between game designers and professor/instructors. The
perspectives were identified through data gathering and analysis. The understanding of disjunctions was accomplished through scholarly analysis and critique.

This Changes Everything!

Our first encounters with a new technology can provide a pivotal moment in our lives. Many people are encountering computer simulation games for the first time. For some, their first introduction to this technology is the massive-multiplayer games which provide rudimentary simulations of a medieval society. For 30 years, teachers in colleges and universities have been reporting how instructional simulations have changed the way they teach. One scholar (Shirts, 1989) has even speculated that the design of simulations may represent a language of the future. In such a future, words will no longer be adequate. Instead we will immerse ourselves in someone else’s view of reality where we will compare their notions of nuance, constraint and possibility with our own ideas. Emerging from the experience, we may be unable to comfortably hold on to our previous beliefs.

The first time I used a personal computer, I played a game. The year was 1981, the game—an outline drawing of a tank that could shoot (and destroy) other outline-drawn tanks, as well as the occasional outline-drawn airplane. I thought of it (the game and the computer) as mindless fun. True, it was interesting but still a colossal waste of time. Then in 1985, I gained access to my first graphical user interface or, as it was known at the time, an Apple Macintosh computer. The very first time I used the word processing feature I realized, “This changes everything!” Gone were the typewriter and the ever-present correcting tape. Suddenly, using word processing I didn’t have to worry about typing each letter correctly; with the help of the backspace key I could just back up over any error. Even better, I might prefer to type with a stream of consciousness awareness and then later return to the text in order to structure and rearrange it. Furthermore, I could create emphasis by changing the size of the letters, or applying a
bold or italicized typeface. This new technology gave me practical experience as an editor. For many years prior, writing had been a labourious chore, but now the possibilities of writing fueled my aspirations. Subsequent research in the primary and secondary systems has confirmed this benefit of educational technology—students enjoy writing more when they have access to word processing software (Becker et al, 1999). The facilitation of writing skills is the most prevalent use of computers in schools. The second most prevalent use is accessing information over the Internet (Becker, 1999). However, while students are able to gain liberal access to text information, they are unable to explore the full potential of graphical, multi-media representations (Anderson & Ronnkvist, 1999). Thus, while students can access information, they have little opportunity to interact with information. Simulation/games offer the promise of interacting with information.

In 1985, I encountered the Internet while working with computer programmers. They were able to send text messages to their colleagues, I was not—none of my colleagues used the Internet. Then in 1994, I completed a computer animation and posted all 900 frames on the Internet, and once again I realized, "This changes everything." These same 900 frames were a 30-second animation on videotape, but on videotape it would only be seen by a few friends. The quality of this facial animation project was comparable to any produced by the professional studios of Walt Disney but it had been made by three people: myself, a computer science student and the professor. It was now available to the several million end-users but only a few hundred would be interested in viewing it. Even these viewers would probably be interspersed over a period of several years. The online network was the only way to connect my modest animation with an appreciative public. Today, the Internet is viewed primarily as a channel for asynchronous, mass-distribution—with a new potential to custom-design products for niche markets. Providers of online education are actively seeking these markets with ever more diverse course offerings.
In 1989, I played my first computer simulation game, Hidden Agenda. Having played the game, I had come to understand that Mexico was not a democracy ‘just like’ Canada. In my day-to-day life I have limited time to analyze topics related to economics, foreign policy and domestic politics. Yet using these entertainment products, I had gained a cursory awareness of relevant issues. Furthermore, the game-play had managed to pique my curiosity. I was now reading books like ‘Manufacturing Consent’ by Noam Chomsky and ‘Cities and the Wealth of Nations’ by Jane Jacobs. I became more interested in public policy issues, tax systems, and diplomatic relations. The games seemed to provide a key to doors which opened new informational vistas.

In 1996, I began to hear the first hype about online education and I wondered, “Will this change everything?” It is the job of experts to create representations of complex systems. If these representations could be translated into the design of a computer simulation game, then learners would: 1) have a new way of constructing their understanding and, 2) be introduced to a broad range of topics they wouldn’t ordinarily have the opportunity to study. Online education and a network distributed to the masses offers the promise of custom-matching this type of learning with those who would like to receive it. Ultimately this opportunity to construct understanding might lead to a different kind of understanding. For instance, learners might be better able to tolerate the ambiguous and contradictory nature of knowledge.

The computer game Colonization allowed me to identify and tolerate contradictions within myself. In this game, European explorers set out for the New World to make their fortune. The mother-country steadily increases the taxation rate. In the end, the user can decide to fight a ‘War of Independence’. If the war is won then the game is won. As a lifelong socialist, I choose to value tax-supported government services and am not persuaded by the corporate critique of government spending. In my considered opinion, the propositions of the fiscal conservatives place too much emphasis on individuality, not enough on communal well-being, with a time horizon that extends
only to the end of the next fiscal quarter. My beliefs changed after playing the game *Colonization*. I was genuinely enraged when the taxation rate (in the game) reached 13% and immediately began building the infrastructure to support a military insurrection. Upon further reflection, I realized that being taxed by a distant power that appears unresponsive to local necessity has been a common theme in challenges to political power. While I still retain my commitment to a tax-supported social service system, I now find the perspectives of fiscal conservatives to be more comprehensible and more accessible.

Other games explored the benefits of tax-supported services. In fact, one computer simulation was recently distributed in the United States just for this purpose. It was called *Sim-Health* and for a brief period it was sold as an educational product. The goal of this product was to explore various public policy issues with regard to the American system of health care. *Sim-Health* was specifically designed as an instructional tool for the purpose of engaging people in the debate. It was not designed as an entertainment product.

On the other hand, *Syd Meier's Civilization* was intentionally designed as an entertainment product. It was very successful commercially and many imitators have tried to build on its success. I knew that as an individual I was having fun with *Civilization* and then I became aware of all the other people who were playing it. Will the mass market acclimatize greater numbers of consumers to the medium of simulation/games? Will competition in the marketplace provide the crucible to test and find the most favourable interface designs? Will computer-assisted-instruction finally move beyond the drill and practice model? The first game I played, *Hidden Agenda*, was designed as an educational product. It did not sell well. By 1995, hundreds of thousands of people were playing computer simulation/games for the purpose of entertainment. It remains to be seen how far this culture will evolve, how fast the various technologies
converge and whether or not this technology will be implemented within the context of formal education.

Learning from a simulation activity is simply "learning-by-doing" but with no real consequences. At the turn of the 19th century, John Dewey was the first to coin the term. It can be observed in the fantasy play of children, the master-apprentice relationship or the everyday activities of our lives. Traditional board games such as chess and Go are often mentioned as early abstract simulations of military strategy. World War II inaugurated the modern era of learning-by-doing through simulations. Cockpit simulators and other physical simulators were used to train operators in order to conserve resources and lives. Since the war, simulations have become more sophisticated in modeling human behaviour and thus offer the opportunity to practice real-world decision-making. The military continues to purchase simulation technology. The town of Orlando, Florida is sometimes called 'Simulation Valley' as a parody of 'Silicon Valley'. In that town, there are over 200 companies creating simulation products. In the 1980s, the literature listed over 1000 simulation activities to be used for the purpose of instruction in colleges and universities. Senior business executives continue to be the most frequent users of instructional simulations.

The Internet and (advent of) online education are gaining momentum and, with it, the power of a broad cultural force. Other technologies are converging with the Internet and simulations/game may be one such technology. If online education is to utilize simulation/games many designers will need to navigate through technical and commercial challenges. Will it be necessary for faculty to be familiar with software development? How ready is the education consumer for simulation/games? Is there a market demand for this type of learning? The underlying assumptions of a changing culture offer hidden challenges. If disjunctions exist between different cultural forces then stakeholders will need to identify and bridge them if the convergence is to gain momentum.
Several arenas of disjunction in higher education can be readily observed within the existing system. This is evident in debates between the public good of education and the private one, the social demand versus the market demand. Fiscal restraint and public policy have grafted the accountability structures of corporations onto the collegial culture of higher education (Hardy, 1996; Currie & Newson, 1998). Research funding now relies more on industry applications than a basic search for new knowledge (Slaughter & Leslie, 1997). Students are viewed as consumers, being prepared for the labour market rather than for the sole purpose of citizenship (Human Resource Development Committee, 1991; British Columbia Labour Force Development Board, 1995). While these issues are a matter of lively debate among stakeholders in higher education, the potential for convergence with “digital culture” is still open to speculation. Even though the value of online education is a topic of intense scrutiny, venture capitalists are ready to invest billions in the private sector and meanwhile, public institutions are expanding their online offerings. Any disjunctions between faculty and game designers will be situated within this overall context.

As an entertainment product, computer simulation games must be easy to understand—by a broad cross-section of consumers, a consumer-base which may include 8-year-old girls as well as adult enthusiasts (at present, the adults are mostly higher-income males in their 20s and 30s). Those designing instruction may view a game used by and 8-year-old as too facile for higher education. The market imperative may guide commercial designers to insist on a design that retains a broad appeal.

Another disjunction will be tolerance for the typical software development process. Professor/instructors receive knowledge that has evolved from decades of debate. Teaching usually involves the transmission of knowledge and student assessments based on retention of content. Teaching practices committed to other perspectives of are in the minority (e.g., apprenticeship, developmental, nurturance and social reform) (Pratt, 1998). In software development, reconfiguring knowledge
constructions happens day-in and day-out...until an agreeable result is achieved. This development process may occur over a two-year period. In the interim, the program may be rebuilt from scratch several times, with a free-wheeling discarding of previous ideas and incorporation of new ones. Typically, it is a search for one design that works and the product of many compromises. Professor/instructors are likely to prefer a development process that emphasizes a pre-planning phase with a minimum of follow-up (as per the usual practice of instructional design: specify the objectives, structure the content, implement and make revisions as needed). Game designers on the other hand, are likely to have a high tolerance for the iterative nature of software development and little opportunity for pre-planning.

If these disjunctions exist, then why should there be any need to remedy them? Large numbers of people are using computer games—all kind of games. These products provoke the curiosity of young people, and allow them to acquire the desire to learn more about information technology. Corporations such as Nintendo already operate their own accredited trade schools to teach people how to design electronic games (Digipen, 2000). The expansion of online education began even before the Internet became widely accessible to the public (Harasim, 1993; Riel & Harasim, 1994). In British Columbia, over the last decade as many as 1500 private agencies have received provincial accreditation including a plethora of film/media schools (Dennison, 1999). One company in San Francisco, Ninth House, has just begun offering just-in-time simulation/games over the Internet for business executives (Armstrong, 2000). Are these isolated anecdotes or do they represent a trend that is gaining momentum? I believe the latter, more people are using computers, in more diverse ways and more educational opportunities are being provided by the private sector—as the momentum of these trends increases, the potential for convergence of technology increases.
Changing Landscape of Higher Education

Simulation/games in higher education are a possibility because a variety of converging trends are influencing the future design of technology-based education. These include:

- Reduced government money for higher education (and research)
- Increasing pressure on faculty to partner with industry
- Increasing acceptance of learning-by-doing (and applied research)
- Increasing acceptance of “situated learning” as a complement to cognitive learning.
- Increasing awareness of failure of online education to utilize the full interactive potential of computers and telecommunications technology
- The increasing trend of mass marketing strategies being applied to mass higher education.

Due to government fiscal restraint in higher education (Hardy, 1996), faculty are under increasing pressure to enter into partnerships with industry (Slaughter & Leslie, 1997). Concurrently, many claims are being made about the utility of technology and distance education (Moore & Kearsley, 1996). These two trends are already converging and at least one university president has been approached by a ‘large information company’ with a business proposal to serve a $30 billion worldwide, online-education market (Uegama, 1999). Many institutions around the globe are increasing their course offerings over the Internet. Some indicators suggest these two trends will converge with a third—the inclusion of computer simulation/game technology. These indicators include web-based listings of instructional simulations that can be accessed online (National Science Foundation, 2000; Maricopa College, 2000), the millions of consumers purchasing entertainment simulations such as Sim-City (Gussin, 1995), and dissatisfaction with the current quality of interactivity in online education (Boshier et al, 1997). Exploiting the power of interactivity is viewed as the primary benefit of
simulations/games (Borsook & Higginbotham-Wheat, 1991; Wager, 1993). The most intriguing indicator may be marketplace.

With the mass-market success of simulation games developed for the home entertainment market (Syd Meier's Alpha Centauri, Syd Meier's Civilization, Microsoft: Age of Empires, Syd Meier's Colonization, Syd Meier's Railroad Tycoon, Maxis: Sim City, Maxis: The Sims), simulations/games may be leaving the shadows of marginalization. The potential for convergence is best indicated by the increasing number of consumers using computer games for the home entertainment market and the broad acceptance of complex user-interfaces which may eventually yield new metaphors of the medium. As explained below, a century ago, other communication technologies were developed and new metaphors emerged that were not possible in the pre-existing media—film was qualitatively different than the medium of actors upon a stage. The emergence of these new metaphors provided new understanding and another way of constructing understanding. The juxtaposition and layering of ideas, emotions and nuance was advanced with the emergence of film technology, and learning-from-narrative was made more accessible to a wider audience. Simulation/games allow learners to construct understanding by immersing themselves in a complex situation, making choices and sequencing information in a way that is personally meaningful—while not deferring to the authority of a knowledge 'expert'. This type of learning is non-linear because a teacher cannot identify a linear, hierarchical structure of knowledge presentation that will be *optimal* for each learner. Rather, the learner is expected to socially construct knowledge in a manner that is optimal for them.

**Emerging Metaphors for a New Medium**

The current state of technology-based education is analogous to the overly dramatic, stage-like representations of the silent film era at the turn of the 20th century. Just as the silent film star, Charlie Chaplin, could not predict the film innovations of
travelling shots, off-screen dialog, and computer animation, we cannot at this point in time predict what innovations will emerge with regard to technology-based education. Just like a camera recording a stage-play, online education is translating distance education into the online environment, or the graduate level seminar into an online discussion group. The new metaphors have yet to emerge. However, the advent of simulation/games may provide some intriguing clues.

In this case, the market-place will function as vast laboratory—testing for mass-acceptance. How much complexity can the consumer cope with? How much plausibility will the consumer demand? What features are considered to be the most motivating by the consumer? Will the consumer identify educational benefits? This study seeks to explore the extent to which commercial designers have already answered these questions, and then critically reflect on the possible disjunctions should they try to collaborate with faculty/instructors on some future incarnation of online education.

Within the landscape of higher education, simulation games have remained a relatively small phenomenon. Our conceptual magnifying glass was turned on simulation/games for the same reason we consider the butterflies and hurricanes of Chaos Theory—a small thing may set in motion a sequence of events which have great consequences. And so a small group of commercial game designers were contacted, surveyed and interviewed. At an industry trade show, computer game designers were first asked if they considered themselves to be designers of computer simulation/games. Twenty-two designers said, “Yes” and then agreed to participate in the study. They completed a 30-minute questionnaire and were then interviewed for approximately 30 minutes. The methodology will be explained in further detail later.
It's about more than winning and losing.

In the simulation/game literature, there is a preoccupation with learning outcomes. The design and development of simulation/games have been infrequently reported. This study seeks to update our understanding of the design and development of simulation/games as these issues may relate to the future design of technology-based education. Therefore definitions must be clarified for the following terms: simulation/games, virtual representations, artificial intelligence, strategy games, shoot-and-drive game, technology-based education, online instruction, browser software and technology convergence.

The term *simulation/game* refers to a simplified model of either a system or the designer's worldview. Two explicit definitions were stated as part of the questionnaire and explored during interviews. These definitions were as follows:

Definition #1: “A simulation game is a contrived activity which corresponds to some aspect of reality. The activity involves players who strive to resolve one or more conflict(s) within the constraints of the rules of the game. It comes to a definite closure with a determination of winners and losers.” (Thiagarajan, 1978).

Definition #2: “A simulation is a working representation of reality. It may be an abstracted, simplified or accelerated model of the process. It allows the exploration of systems where reality is too expensive, complex, dangerous, fast or slow” (Jones, 1980).

This study will utilize the convention of dividing the term *simulation/game*. Even within the academic community there is controversy about what constitutes an appropriate definition of the term. Dividing the term in this way appears to be generally accepted (the primary journal is named the *Journal of Simulation/Gaming*). One definition
embraces the concept of closure, with a specific determination of winners and losers. The other definition resists closure, preferring to emphasize an open exploration where the end-user modifies variables to explore the dimensions of a system. One hypothesis is that commercial game developers were expected to prefer closure. The pilot study indicated that professor/instructors may prefer open exploration. Thus the differing definitions might provide some indicator of disjunction.

The term virtual refers to a contrived representation or character which exists only within the context of the computer simulation/game. It may refer to a role, complete with a description of human being and an image, or to an abstraction, such as a competitor nation or company. The computer programming instructions which guide the actions of these virtual characters are referred to as the artificial intelligence of the simulation/game. The term strategy indicates a sequence of decision opportunities which may follow (or evolve from) one of several perspectives. The term game refers to a mental activity where tactics of competition conform to a set of rules in the pursuit of an object, with a final determination of winners and losers. The shoot-and-drive game refers to the most common type of computer game where the object is to kill objects on the computer screen and navigate the player's piece through the environment presented.

Technology-based education refers to some combination of computer and telecommunications technology used for the purpose of instructing students. The term computer refers to personal computers based on a single microprocessor. The term telecommunications refers to network-based communications such as the Internet. The term online instruction refers to a student using a computer to log-on to the Internet (through telephone lines or other high capacity transmission lines). The computer must be equipped with browser software which provides a graphical user interface to the Internet. Currently, the two most common browser software products are Microsoft Internet Explorer and Netscape Navigator.
Post-secondary education over the Internet usually offers a group of students common access to web pages and discussion groups. Students may also be required to obtain reading packages of printed material or an accompanying CD-ROM (a disk which can store 650 megabytes of information). Typically these online courses are oriented towards the transmission of knowledge content. The teaching perspective associated with transmission of content is evident where the primary commitment of the instructor is to (a) accurately represent the content, (b) demonstrate an enthusiasm for the content, and (c) encourage people to consider the content (Pratt, 1997). Online courses tend to rely primarily on communication through text. There is a limited focus on problem solving, decision-making or interactivity with an expert (although students may be encouraged to interact with each other through the discussion group). In contrast, computer simulation/games offer abundant opportunities for problem solving, decision-making and interaction with an expert's view of the world (albeit an abstract construction of that expert's worldview).

In the future, computer simulation/games could be distributed to students via CD-ROM or even directly over the network to the student's computer. Students could then engage the game as a single player, or play each other in a multi-user version of the game. Their subsequent debriefing (through discussion groups and with professor/instructors) would be the primary opportunity for learning. To date there is no evidence that simulation/games are used as part of online instruction. However, computer simulation/games are being used in conventional classroom instruction. Convergence refers to several technologies merging to form one technology. Currently, three separate technologies exist: (a) classroom computer simulation/games, (b) online instruction, and (c) home entertainment simulation games. What is a) the rationale and, b) the potential for convergence of these three technologies? That is the larger question surrounding the research objectives of this study.
It’s Not About Pac-Man

Most computer games are of the shoot-and-drive variety where the primary design challenge is to provide more multi-media effects (e.g., colour, 3-D visuals and quality sound) through a limited data processing channel. In comparison, computer simulation/games attempt to represent human decisions in a virtual problem-solving environment. Simulation/games may also be referred to as discovery learning, microworlds and scenario education. Furthermore, simulation/games usually provide the end-user an opportunity to solve the problem by approaching it from several different perspectives. These type of computer games can provide a virtual apprenticeship in negotiating and navigating through complex environments. Therefore, the primary design challenge associated with simulation/games is the creation of a plausible model/construct of reality (or fictional context)—a model which satisfactorily includes all relevant expert knowledge and yet does not overwhelm the student/user with complexity.

The focus on decision-making, problem solving and exploration of different perspectives indicates that this educational technology is appropriate to the pursuit of teaching and learning in higher education. Learners (as well as consumers of entertainment simulation/games) are expected to (a) identify interrelationships among a number of variables, (b) make rapid and effective decisions about allocating resources and negotiating, and (c) deal with various strong feelings and emotions associated with the instructional topic (Thiagarajan, 1978). In addition, they may be expected to (a) transfer their skills and knowledge to a real-life situation, and (b) eventually interact with others in the real-life performance of a situation.

The distinction between shoot-and-drive (S&D) games and computer simulation/games is as important one because most computer games are of the first variety and typically only need to employ programming specialists (thousands of S&D games are produced each year while only a few simulation titles are released). The non-programming specialists associated with shoot-and-drive games will tend to be experts in
multi-media (i.e. graphic artists, audio engineers and computer animators). These specialists focus on the quality of the multi-media effects and are not primarily concerned with how the end-user constructs meaning and mental models from a complex system. The developers of simulation/games, on the other hand, must be very concerned about the student/user's opportunity to construct meaning. While engaged in a complex system of a simulation, the activities may include allocating resources, managing many interrelated variables, sequencing actions, linking relevant information and negotiating with other players (either real or virtual). The data presented by the game must be sequenced and processed to facilitate decision-opportunities. At each step of the development process, content experts of simulation/games must make decisions about the quantity of data, complexity of data and the availability of data (i.e. the end-user may have access to certain features of the game, but is denied access to other features). The developers of a shoot-and-drive game are likely to hire programming experts and multi-media specialists. The developers of simulation/games are likely to employ these same experts but also need to access content expertise.

Computer simulation/games are attempts to model complex processes, processes which can be viewed from several different perspectives. The design of these computer software products is unto itself also a complex process. The design effort must be guided by how the student/user constructs meaning from his/her actions and engagement with the simulation/game. This is perhaps why the literature about instructional simulation/games focuses so resolutely on learning outcomes. Since the 1950s, the research has been accumulating evidence that simulation/games are at least as good as conventional instruction, especially with respect to content retention. Does the focus on content retention miss the whole point of engaging a simulation/game? Is the retention of content the only indicator that the student/user has constructed appropriate meaning? Given the development process of a complex product, this study was undertaken with an expectation that themes would emerge from the data that would illuminate these two
questions. In short, home entertainment game designers would want to design products which were highly motivating (i.e. fun) and included subjective representations of knowledge. On the other hand, professor/instructors would want to design products that would be useful to students and represent a more objective view of knowledge. If this disjunction exists then any prospective collaborative effort between the two groups would be fraught with constant battles over how student/users construct meaning (of objective knowledge) and the validity of content retention as an end-user outcome. If the disjunctions do not exist then presumably both parties would be more open to a development process which would allow the design to evolve as part of the process.

Game designers interviewed for this study were not expected to ‘reinvent the wheel’ but instead asked to respond to questions about design. The intent was to determine if early conceptions of design retain any validity for the future of technology-based education. Would it be relevant for game designers and professor/instructors to discuss these issues should they attempt a collaboration? Only a few sources attempt a description of the design and development process. The term ‘design’ refers to the technical specifications that must reside within the product at any given stage of development. The ‘development process’ refers to the interpersonal dynamics of a team of people working together over a period of time. A review of the literature suggested three themes that might be potential indicators of possible disjunctions: a) a preference for a specific closure or an open exploration, b) a commitment to either subjective or objective representations of knowledge, and c) a preference for pre-planning the design, or a tolerance for the iterative nature of software development (Thiagarajan, 1978; Jones, 1980; Robinson, 1985; Ehrmann & Balestri, 1987).

Most of the simulation/game literature dwells on the validity of learning outcomes related to the transmission and retention of knowledge content. The literature also seeks to validate other learning outcomes such as changes in attitudes, beliefs and behaviour. There are very few reports about the design and development of simulation/games, and
none concerning commercial game developers. This study is undertaken in response to this lack of research in the (proactive) hope of identifying a potential overlap should disjunctions be identified between game designers and professor/instructors.
CHAPTER 2

FOUR DECADES LATER

Early on there was great enthusiasm for the 'new' technology of instructional simulations. But beginning in the 1980s, researchers (Shirts, 1989; Greenblat, 1989, Duke & Kemeny, 1989; Shubik, 1989) tried to answer the question, "Why aren't more people using this compelling teaching method?" Most of the studies recorded in the *Journal of Simulation and Games*, measured learner outcomes with a specific emphasis on retention of content. Practitioners has underestimated the degree of entrenchment of traditional modes of instruction and student assessment did not value the type of learning offered by gaming. The learning offered by simulation/games would have to conform to the culture of existing institutions. While other kinds of learning outcomes were noted (i.e. attitude change, behavioural change and tolerance for ambiguity), the assessment of these outcomes were not usually relevant to student assessment. Institutions of mass-education still rely primarily on assessing student progress on the basis of how well content has been 'transmitted' to the student and 'retained' by them. Therefore it is not surprising that faculty did not go to the trouble of using a new, compelling teaching method when the incentives of the institutional culture principally support 'transmission of content'. This chapter will review: a) the literature associated with instructional design, b) literature of educational technology for distance education, and c) the studies reported in the *Journal of Simulations and Games*. The review indicates that: (a) simulation/games have been a subject of research since the 1970s, (b) learner outcomes have been the most frequently reported result, (c) the theoretical perspectives of
instructional design inadequately represent the constructivist nature of learning through simulation/games, and (d) online education is not yet using simulation/games.

If researchers continue to claim that simulation/games will eventually be used for online education they should be challenged to provide evidence that supports this claim. This review of the literature suggests the design of simulation/games has been idiosyncratic and not a frequent subject of systematic inquiry. Furthermore, the instructional design literature (Richey, 1986; Kember, & Murphy, 1990; Merrill et al, 1990; Gagne, Briggs, & Wager, 1992; Gustafson, 1993; Hwang, 1995; Shrock, 1995) provides few clues as to how to proceed with a constructivist learning process—where the learner is exposed to a new information set, problem or situation, and then extracts/exploits that set/problem/situation to create new and personally relevant meaning. The most commonly used guidelines for designing instruction are embedded in an objectivist epistemology and oriented toward transmission of content (and sometimes apprenticeship). Guidelines which attempt to outline a constructivist orientation to instructional design succeed in describing the value of constructivism but fail to capture a step-by-step explanation of the process.

The lack of systematic inquiry into this area may indicate that the complexity of the design process presents too large a barrier. The purpose of simulation/games is to represent complexity—to immerse the student/user in an environment of uncertainty and ambiguity, to construct meaning from the experience which is personally relevant and allow them to manage decisions in a virtual environment. The intent of this study is to wade, however naively, into the waters of simultaneous complexity—the design of complex representations and the complexity of the design process. Systems theory
advises us to develop an appreciation for emergent complexity and an awareness that the whole may be greater than the sum of the parts, but as a theory it does not give us a framework for analysis. The paucity of theoretical perspectives with regard to complexity suggests that the product and process of designing of complex representations may be difficult to separate.

**History of Simulation/games and Education**

Most of the simulation/games reported in the *Journal of Simulation and Games* referred to classroom or seminar activities. Most are business simulations. However, an example of a widely used classroom simulation would be those related to sociology. For instance in STARPOWER, students were divided into socially-stratified groups and then assigned privileges based on their rank in the simulated society. This society would then test tenets of sociological theory (i.e. Would the elite willingly share their privileges? Would the lower strata be satisfied with letting the society evolve or would they be motivated to revolt?) (Dukes & Mattley, 1986). A few studies in the journal reported on simulation/games used at the high school level, most were oriented toward adult education, either in the workplace setting or at a post-secondary institution.

The development of educational simulations began in the 1950s (Faria, 1987). Computers were used even with these early simulation activities (primarily to calculate points at the end of the round, much as we would use a calculator today) (Crookall, 1986). From the 1950s to the early 1980s, the typical simulation was published in text form and instructors would refer to these manuals and then act as facilitators during the simulation (which was delivered in a workshop or seminar format). These simulations
were intended to run several hours consecutively at a time (or over several days as needed). This type of time commitment was not always compatible with conventional classroom instruction (Greenblat, 1989; Shirts, 1989) and may suggest the reason why many simulations concern training for professionals and management executives. A significant number of articles in this journal describe simulations which are related to a specific job-context. Examples of the history of simulation/games include the following content topics: management training (Biggs, 1978), accounting (Specht & Sandlin, 1991), labour relations (Brenestuhl & Blalack, 1978), entrepreneurship training (Low et al, 1994), urban planning (Kennedy, 1973), international relations (Modelski, 1970), law (Hollander, 1977), teacher education (Tansey, 1970) and even child care (France & McClure, 1972). Another article listed over 1000 simulation games available for college and university instruction (Birnbaum, 1982). Hence simulation gaming has a substantial history and has been associated with higher education for at least four decades.

Learning Outcomes of Simulation Games

A strategy simulation game provides a virtual apprenticeship in decision making. Games are usually designed to describe a complex, uncertain and ambiguous environment. The student/user must successfully negotiate with and navigate this environment while engaged in solving problems (Norris & Niebuhr, 1980). As part of the process, the student/user may choose to approach the problem from a particular perspective. It is probable that the player will encounter other perspectives—those other of players or the biased abstractions of the game designer (as represented in the artificial intelligence of the computer program). The literature is consistent in
emphasizing that the primary learning opportunity is the debriefing of learners after the
game has been concluded (Gamson & Stambaugh, 1978; Petranek, 1992; Thatcher,
1990). The measured outcomes have included variables such as attitude/affect change
(Orbach, 1977), behavioural change (Duke & Mattley, 1986), and tolerating ambiguity
(O’Leary, 1971).

Many published studies focused on comparing simulation games to conventional
instruction where the primary outcome measurement is content retention. Predictably,
these studies have achieved mixed results. Some indicated no difference in content
retention between the two types of instruction (Keeffe et al, 1993; Randel et al, 1992;
Others claimed conventional instruction allowed more content retention (Boseman and
Schellenberger, 1974). Others said simulation/games encouraged better learning (Page
& Roberts, 1992; Stembler, 1975; Braskamp and Hodgetts, 1971). Other longitudinal
studies claimed that remembering content over a period of several months was better
for simulation/games (Sprecht & Sandlin, 1991). This line of inquiry suffers from the
inherent complexity of simulation gaming. As a learning outcome, content retention is
primarily a feat of sensory perception and memory. Simulation games also engage
elements of personality (e.g., extroversion, introversion, ambition, aggressiveness,
reticence, etc.), social ability (i.e. ability to assess social relationships, persuade,
charm, tolerate ambiguity, etc), as well as higher forms of cognitive thinking (i.e.
analysis, synthesis) (Keegan, 1994). Simulation games also invite a reflective
contemplation of personal values and belief systems. While conventional instruction
may intend to engage many of these same elements, it does so in an indirect manner, and ultimately changes in these elements are not measured or evaluated. Simulation games directly engage the elements of personality, social ability and value/belief systems. The debriefing process provides the opportunity to re-evaluate changes in these elements. In comparing simulation/games to conventional instruction, measuring content retention fails to acknowledge the complexity of learning outcomes for simulation/games.

**Theoretical Perspectives for Teaching, Learning and Instructional Design**

Only a few resources are available to those who might be interested in designing simulation/games, and even fewer are available to describe the design of computer simulation/games. The design of modest computer simulation/games for a high school setting has been described (Keegan, 1994). This resource offers a thorough review of the relevant learning theories and psychological research with regard to instructional design of simulation games. While it is an adequate how-to primer for small games, it offers little advice on how to develop the larger, complex games that would be more appropriate for adult education. Like most of the constructivist literature, it seeks to validate the value of constructivist theory but fails to provide step-by-step guidelines for designing software. However, Keegan (1994) developed a software product which accompanies the book and can be used by high school teachers (and students) to design relatively simple simulation/games.

In designing simulation/games for a post secondary system, professor/instructors may insist on approaching the task from their perspective as teachers. One theory
suggests five possible perspectives: transmission of content, apprenticeship, developmental, nurturing, and societal reform (Pratt, 1998). Of particular interest to this study is a contrast between transmission of content and the developmental perspectives. Within the context of institutional education, the transmission of content is the most common form of teaching. In this perspective, the primary commitment of the teacher is to express a deep respect for the content by accurately representing the content, demonstrating an enthusiasm for the content, and encouraging student/users to consider the subject. The developmental perspective is a relative newcomer to post secondary institutions and challenges many institutional constraints, in particular the requirement of evaluating student progress. The key belief of the developmental perspective is that learning depends on building effective bridges between present and desired ways of thinking. The primary challenge for the instructor is to assess the student’s prior knowledge and begin instruction at this point. The end point is not a successful retention of content, but a new way of thinking about the content. Thus of all the teaching perspectives, the developmental perspective may be the most complementary to the kind of instruction offered by simulation/games.

The apprenticeship method is also a time-honoured way of providing learning opportunities. The expert is continuously present to provide guidance as needed to the apprentice, and act as mentor initiating the apprentice into a community of practice. But in the modern world, the matching of apprentices to an expert in a resource rich environment is often viewed as too expensive. Many computer technologies have attempted to recreate this relationship with the computer as ‘expert’ and the student as ‘apprentice’—so far none has succeeded (Woolf, 1990). Most versions of computer-
assisted-instruction are little more than drill and practice (Suppes, 1990). The limitations of expert systems and artificial intelligence have been described (Illovsky, 1994). Useful applications of artificial intelligence and neural networks have yet to emerge from the research laboratory. But combinations of these technologies are producing useful tools. The architecture of a computer simulation/game is usually framed around an expert system of rules. Artificial intelligence is used to animate and activate the virtual competitors who play against the end-user. The design team uses a combination of these technologies to give the 'appearance' of a knowledge master. If professor/instructors were proficient with these same tools and processes, they might succeed in creating a virtual apprenticeship in decision making—a cognitive apprenticeship.

Learning through apprenticeship has been an expensive, labour-intensive process. Computer simulation/games distributed through online education may represent an opportunity to realize some efficiencies. If computer simulation/games succeed in recreating the master/apprentice relationship, the professor/instructors may need to retreat from 'transmission of content' and embrace the teaching perspective of apprenticeship.

Apprenticeship learning in a work environment offers the opportunity to create personally relevant meaning. Work environments also create a context for learning that is associated with high levels of learner motivation. One author reports the dysfunctionality of conventional classroom instruction (Raizen, 1994). This is an overview of theory and practice as it relates to the informal learning of apprenticeship programs. Conventional instruction emphasizes declarative knowledge, while apprenticeship learning usually emphasizes tacit procedural knowledge. Theories of situated learning emphasize the importance of the environmental context that surround
the learning opportunity. The ideas of 'socially constructed knowledge' and 'learning from error' also emphasize the relevance of environmental context. The theory about transition from novice to expert offers a rich model for considering learning through simulation/games (Milech et al, 1993). When learning something new, a novice accesses fragments from a variety of models, and does so incompletely and inadequately. After a process of experimentation, trial and error, the novice begins to synthesize the fragments into an entirely new model. Experts can be characterized as those who have synthesized many different models into new more efficient and robust models. Simulation/games may offer the learner a rich resource of models from which they can pick and choose a variety of fragments. Simulation/games also offer a meaningful context for experimentation, as well as trial and error.

Traditional perspectives of instructional design are grounded in behaviourist and cognitive epistemologies (Gagne, 1992). These perspectives are not appropriate for the simulation games because the focus is on systematically designed instruction that focuses on the attainment and measurement of fixed objectives. Simulation games immerse the learner in complexity, and the learner chooses how to and in what sequence to manage that complexity. Other authors have tried to review the variety of instructional design perspectives that go beyond the behaviourist perspective (Romiszowski, 1981, 1981a). None of the well known models of instructional design has proven to be applicable in every situation. Eight different types of instructional design were described, from reception learning (conventional rote instruction) to impromptu discovery (unplanned learning). On this continuum, guided-discovery most
closely resembles simulation/games, where objectives are fixed and the learner is
guided to appropriate methods. However, in a simulation/game the student/user often
chooses the objective. A less than optimal choice of strategy may be just as instructive
as choosing an optimal strategy. These tactics of traditional instructional design assume
the learner will always need to approach the content in the following ways: (a) from
simple to complex, (b) from known to unknown, (c) from particular to general, and (d)
from concrete to abstract. The immersive environments of simulation/games challenge
these tactics—often the learner must reverse tactics (i.e. from the complex to the
simple, unknown to known, etc.)

One theoretical perspective offers insight into the difficulties of categorizing the
kind of learning offered by simulation/games. The instructional design of simulation
games could be more aptly described by a constructivist epistemology (Jonasson et al,
1995):

The constructivist sense of active learning is not listening and then
mirroring the correct view of reality, but rather participating in and
interacting with the surrounding environment in order to create a
personal view of the world (p. 11).

While constructivism makes claims for the value of this orientation, it does little to
guide the designer. Two main features of constructivist instructional design require
more how-to guidance: interactivity and problem solving. Designing for interactivity
should include the following considerations (a) immediacy of response, (b) non-
sequential access of information, (c) adaptive communication, and (d) bi-directional
communication (Borsook & Higginbotham-Wheat, 1991). Designing for problem
solving would focus on cognitive operations that transform the mental representation of
objects, both images and concepts (Dijkstra, 1991). Declarative knowledge is
developed by solving problems, and the operations must allow the learner to discover
relationships between objects. The author then claims that “there is no clear
instructional design model for the teaching of relational concepts.” (p. 23). Managing
the complexity of a simulation/game is dependent on analyzing the relationships
between many different variables. Therefore, with respect to the design of
simulation/games, the current state of instructional design theory is impoverished and
may not provide a clear theoretical focus to analyze data yielded by this thesis.

**Relationship of Simulation Games to On-line Education**

On-line education refers to education over the Internet, or any learning mediated
through a combined use of telecommunications technology and personal computers.
Current research with regard to on-line education occasionally suggests that simulation
games will be able to reap the potential of these new technologies (Gustafson, 1993;
Jonassen, et al, 1995). These suggestions imply that potential resides with interactivity
(i.e. learner-to-learner, learner-to-instructor, learner-machine) and knowledge
representation (i.e. through expert systems, intelligent tutoring systems, multi-user
domains).

To date, there is little evidence to support the claim that simulation/games will
be included in online education. Much of what currently exists as on-line education is a
reappearance of conventional classroom instruction with a continued focus on content-
retention (Boshier, 1998). Simulation games are currently not being widely adopted in
on-line education.
In Canada, there is a national effort to explore the potential of tele-learning technologies (Harasim, 1995). These studies are attempting to validate subjectivist epistemologies from the constructivist perspectives of Vygotsky—the main learning benefit occurs as a result of learners “telling what they know” to others. This line of research will support and validate the interactivity potential of the new technology but offers little with regard to knowledge representation.

The issue of knowledge representation and computer games has been more fruitfully explored with regard to learners in the K-12 education system (Sedighian, 1998), but again the learning emphasis is on content retention. Developmental models for adult education emphasize the need for learning to relate to immediate application in everyday life—the intended learning must be relevant to the adult’s needs (Richey, 1986).

Gaps in the Research

In the scholarly literature related to simulation/games, ‘design’ is the least described aspect. This study addressed that deficiency.

Although many simulation games have been developed and utilized, practitioners have not reflected much on the process of development. Rather they have focused attention on the products of development. In general, simulation games as products have not been easily transferable from one teacher to another. Often, these products have been developed by a master teacher who then used the simulation games in his/her own instruction activities. However, most other teachers have not found simulation games to be as compelling and the simulations have, for the most part, failed to be adopted by
other instructors (Shirts, 1989). Much of the research seems to be designed to encourage other teachers to use simulations by validating the compelling nature of simulation games. To this end, the research has focussed more on the products than the process of development.

**Software Engineering: Computer Games**

In general, the development of software has proven to be complex. Nevertheless practical guides have been published (McConnell, 1996, 1998) and seminars conducted (Hendrick, 2000). People employed in the computer game industry have found it useful to distinguish computer science from software engineering. The computer scientist is ‘building to learn’ while the software engineer is ‘learning to build’. As McConnell noted:

Scientists learn what is true, how to test hypotheses, and how to extend knowledge in their fields. Engineers learn what is true, what is useful, and how to apply well-understood knowledge to solve practical problems. Scientists must keep up to date with the latest research. Engineers must be familiar with knowledge that has already proved to be reliable and effective. If you are doing science, you can afford to be narrow and specialized. If you are doing engineering, you need a broad understanding of all the factors that affect the product you are designing. Scientists don't have to be licensed because they are chiefly accountable to other scientists. Engineers do have to be licensed because they are chiefly accountable to the public. An undergraduate science education prepares students to continue their studies. An undergraduate engineering education prepares students to enter the workforce immediately after completing their studies (1999, p. 1).

The personality characteristics and educational backgrounds of computer programmers has also been summarized (McConnell, 2000). The standard Myers-Briggs personality inventory describes a large percentage of programmers as follows:

Two large studies have found that the most common personality type for software developers is ISTJ (introversion, sensing, thinking, judging), a type that tends to be serious and quiet,
practical, orderly, logical, and successful through concentration and thoroughness. ISTJs comprise 25-40 percent of software developers (McConnell, 2000, p.1).

From another perspective, a recent college graduate offers the tale of his entry into the industry through an internship (Scheib, 1999). These reports provide clues concerning the overall context of software development but non-programmers may need to be introduced to its technical aspects if they are to participate in the development process.

During the 1980's it was possible for one person with a modest awareness of software programming to design a computer game. Today the process requires highly trained specialists. In some cases, academics in artificial intelligence come to the computer game industry to learn about advances in the practical applications of AI (Woodcock, 1999). Some game designers are drawing upon the insights of new fields of thought such as emergent complexity and chaos theory (Leblanc, 2000). The 1980s was the decade of Pac-Man, the first video arcade game to reach a mass market. The video arcade market exploited the dynamics of human psychology. Much of this experience served to standardize features of the user-interface (Loftus and Loftus, 1983). In that decade, the debate concerned violence, gender differences and the addictive nature of video games, but little information was published with regard to the technical aspects of development.

As the industry grew and matured in the 1990s, publishing venues were able to make software development process more understandable. Non-programmers could gain an appreciation for technical issues by reviewing descriptions of game design documents (Ryan, 1999a, 1999b; Gordon, 2000), as well as 'post-mortem' descriptions of computer games that had completed the development cycle. Examples of post-mortems include...
Age of Kings (Pritchard, 2000), Droidworks (Blossom & Michaud, 1999), Command and Conquer (Stojsavljevic, 2000), Thief (Leonard, 1999) and Star Trek (Saladino, 1999).

Another useful exercise involved examining the flowchart of ‘technology development’. Many products included a poster which described how technology must be discovered in the context of playing the game. How well the game corresponded to real-life often depended on the underlying assumptions of technology development (Watrall, 2000). In addition, criticism of game design is a robust feature of the industry and occasionally a reviewer will engage in a rant or two (Adams, 1999, 2000a, 2000b). These sources of information could offer professor/instructors some assurances that it is not necessary to become a programmer in order to participate in a collaboration with a software development team. Programmers in the computer game industry regularly collaborate with other specialists such as writers, artists, audio technicians, lawyers, marketers and business executives.

Conclusion

Managing complexity is the primary challenge facing learners. Learning through simulation games may provide one tool for learning to manage complexity. But the paradox is that the designing of simulation/games may have proven to be too complex. To date, there is a paucity of theoretical and practical work to guide an exploration of the design of simulation/games. Only a few articles have described the design of simulation/games and these have focused on classroom activities rather than computer software products (and certainly nothing intended for online education). Theories of instructional design are inadequate because they fail to capture the complexity of
constructivist learning. Professor/instructors may need to change their teaching perspective from transmission of content to a developmental or apprenticeship perspective. From these two perspectives, professor/instructors may be more amenable to the type of learning offered by simulation/games, primarily because these two perspectives support the personal construction of meaning and are not as objectivist as the ‘transmission of content’ perspective. The apprenticeship model fosters the inclusion of a learner within a community of practice where situated-learning is dominated by the context. Simulation-games can offer rich contextual environments. The developmental perspective intends that the learner become more aware of the process of learning rather than the product—thinking about thinking. The learner’s understanding moves from Point A to Point B. The instructors role is to assess where Point A is for each individual learner and facilitate a bridging to Point B. Simulation-games offer the learner a choice of perspectives. They can choose one that is the closest match to their own worldview. They can then choose the difficulty level they are comfortable with. While engaged in the game, it is a useful strategy to intuit the intent of the designer—thinking about the designer’s thinking. In this way the meta-cognitive goal of the developmental perspective is achieved.

Ultimately, it remains to be seen if the communications revolution will in some way cause a paradigm shift from an objectivist epistemology which currently governs our scientific paradigm to a paradigm which validates a more subjectivist epistemology. The institutional contexts of the education system, in both K-12 and post-secondary, continue to emphasize content-retention within an objectivist epistemology.
Simulation/games (and the multiple perspectives they represent) challenge objectivism. Is it possible to design simulation/games where all the competing perspectives are “correct”? As the saying goes “all models are wrong...some are useful.” If the goal of higher education is to encourage students to critically evaluate the constraints of all objectivist notions and develop a greater appreciation of subjectivist influences, then learning through simulation/games provides an optimal opportunity to develop this awareness. Therefore, in researching the design of simulation/games we may find one theme resonating through the collected data—a tension between those who are committed to objectivism and those who wish to acknowledge subjectivism. As this study will demonstrate, the evidence for disjunctions is centered around this tension.
CHAPTER 3

METHODOLOGY

The future may hold the opportunity for professor/instructors to collaborate with computer game designers. New institutions supplying online education may wish to position their product in the market-place by offering a 'new' and compelling kind of learning through simulation/games. If professor/instructors enter into such a collaboration, it may be useful for them to know what to expect. There may be significant disagreement or disjunctions between game designers and professor/instructors on a number of issue. This study tried to identify three possible dimensions of disjunction.

One group of game designers was identified and asked to complete a questionnaire. The respondent answers were then to be used to structure a follow-up interview. The intent was to identify features of the design and development process of simulation/games, and determine if home entertainment game designers held a perspective different from professor/instructors. The questionnaire was written using information from the early literature on the design of simulation games. It provided a common context for respondents. It provided language and a structured way of thinking about the topic, and respondents were encouraged to evaluate its relevance to the topic. Follow-up interviews provided qualitative data and an opportunity to explore identified themes in more depth.
Three Possible Themes: A Theoretical Rationale

The theoretical rationale is that the actions of game designers will most likely be guided by the need to serve a mass market of consumers, and therefore as designers they will prefer games with a specific closure and, during the design process, will need the freedom to explore subjective views. In some sense, these game products need to provide comfort to the consumer. In addition the game designers will indicate a high tolerance for the iterative nature of design. For a typical game title, the development team will be comprised of 5-10 people who will work together for 1-2 years. This opportunity is rarely afforded to professor/instructors for the purpose of developing one instructional module for the reasons mentioned below.

In the pilot study, one professor had successfully guided a team through the development of a computer simulation/game (promoting sustainable development). His resources included several million dollars and several graduate students. He indicated a commitment towards representing objective information and preference for open exploration. End-users of this product could modify variables over the course of a ten-year virtual life. Various scenarios could be explored but each decision involved trade-offs.

Open exploration is preferred because the academic enterprise often involves thoughtful consideration of difficult problems where answers are seldom obvious. Furthermore, the same problem is often viewed from different models. Each model provides a different abstraction. Sometimes insights yielded by one model contradict those of another. One model will try to capture the breadth of an issue while another
theory will explore the depths of one particular facet. The student is expected to
develop critical thinking and a more sophisticated awareness that no model should be
accepted at face value. Therefore, the instructionally-oriented simulation intends that
the student be immersed in a complex situation without access to an easy or comforting
resolution. In some senses, the academic simulation provides discomfort to the student.

In addition to objective representations and open exploration, professors are
presumed to prefer a development process that favours pre-planning rather than an
extended iterative design process. The organizational culture of higher education
institutions has been established for at least 150 years—the professor presenting
instruction from a structured curriculum based on a body of accepted research. The
cultural context of existing institutions is difficult to change (Morgan, 1986).
Furthermore, the university professor is somewhat constrained by administrative bodies
such as the faculty committee and senate. The curriculum of regional colleges are
further constrained by governmental review boards. Another consideration is that
students might object to being ‘guinea pigs’ while the faculty member ‘works out the
bugs’ of his/her instructional design. For all these reasons, professor/instructors are
likely to prefer an emphasis on pre-planning. Even when it is financially feasible to
fund a team of instructional designers over an extended period (i.e. a distance education
module delivered to thousands of learners), there is still an emphasis on pre-planning
with the requisite identification of clearly specified objectives. Once the objectives are
identified, much of the design activity revolves around structuring learning experiences
to achieve specified objectives. Radical rewrites of an instructional design are unlikely,
whereas in the game software environment a radical reworking of the design can happen throughout the development process.

The Original Intent

In this study, the purpose was to identify the design perspectives of simulation/game designers working in the home entertainment market and analyze for possible disjunctions between game designers and professor/instructors. The original intent was to identify a faculty group for this study that consisted of 24 professor/instructors currently teaching in the post secondary system of British Columbia, Canada. These professor/instructors were to be currently using or designing computer simulation/games and intending to translate these games to online education at some point in the future. The sample of game designers was to consist of individuals who were identified among the possible 4000 attendees of the Computer Game Developer’s Conference (1999) in San Jose, California. These game designers were to have previous experience designing simulation/games. It was expected that most of the game designers would be residents of the United States.

These non-proportional samples were to be identified through a snowball strategy. Participants were to be approached by the researcher and invited to participate in the study. They could be approached either in person or by telephone, and then given the letter of introduction/release form. In addition, each participant would be asked to identify others who might be interested in participating in the study.

A pre-interview questionnaire would be administered to each participant. The questionnaire was to be administered in person or by mail. Each participant would take
about 30 minutes to complete it. The interviews would be conducted by telephone for a duration of approximately 30 minutes.

The Pilot Study

To develop the questionnaire, several pilot interviews were conducted. Three game designers were interviewed at the Computer Game Developer’s Conference (Long Beach, California 1998). One of the game designers was considered a ‘legend’ in the industry. This individual was a keynote speaker at an event entitled “The Legends of Game Design” (approximately three thousand people attended this keynote event). The second game designer had developed several types of games (including simulation/games). The third game designer was a novice who intended to develop simulation/games but had not yet done so. In November 1998, at the University of British Columbia, two people associated with the development of a simulation/game were interviewed (this software product was intended to increase awareness of sustainable development issues). One person was the computer programmer associated with the project (he wrote his master’s thesis on the subject of design issues). The other individual was a professor who, during a period of several years, supervised the overall design of the software product (distributed in October of 1999). These pilot-study interviews were used to structure the questionnaire and interviews conducted in 1999.

The questionnaire asked each participant to (a) identify their relative agreement with two possible definitions of a simulation/game, (b) identify the importance of 28
possible end-user outcomes, (c) identify the relative priority of 13 design
classics, (d) indicate their expectations of what they intend to contribute to the
development process (from a list of 21 items), and (e) indicate their expectations of the
development process (relative efforts directed towards pre-planning versus iterative
design—evaluate 13 criteria). The respondents should have been able to complete the
questionnaire within 30 minutes.

Prior to the interview, the survey was reviewed to reveal any internal
contradictions in the respondent’s answers. Surveys were then reviewed to determine if
themes could be identified.

The interview phase of the study was intended to be a qualitative exploration.
The respondents were invited to participate in a 30-minute telephone or face-to-face
interview recorded on audio-tape. The interviews were then transcribed and the text
data entered into a computer-based document. The interview data were analyzed for
categories and themes.

Questionnaire

The questionnaire included a variety of phrases to identify indicators related to
three possible issues:

a) Open exploration versus a specific closure.

b) A commitment to represent knowledge objectively or subjectively.

c) An emphasis on pre-planning or a tolerance of the iterative nature of
development.
Home entertainment game designers were expected to favour some indicators (e.g., closure, subjectivity and iterative development) while other indicators would be favoured by professor/instructors (e.g., open exploration, objectivity and pre-planning). Other indicators were expected to be neutral in that both groups would favour (or disfavour) them, or the responses would be sufficiently random. The anticipated disjunctions between game designers and professor/instructors is summarized in Table 1 of Appendix VIII. A copy of the questionnaire appears in Appendix III.

Most of us enjoy playing games and we are familiar with the consequences of winning and losing. Most simulation games are designed to provide this kind of specific closure. End-users will experience outcomes that include ‘winning or losing’, ‘competing with other players’, ‘competing with other perspectives’, ‘feeling personal risk (thrill of victory, agony of defeat)’, and ‘an identified closure’.

Another kind of simulation/game exclusively involves open exploration. There are many variables which can be modified endlessly. The purpose of this type of simulation is to experiment with many different variables and ‘reflect on the consequences’. The end-user does not compete but rather ‘acts like the god of the game’, accessing any of the variables and changing them as desired. A design that facilitates open exploration allows end-users to have no ‘experience of a final determination’. Typically, there are advantages and disadvantages for any strategy that is chosen.

Objective representations of knowledge are common in the design of instruction. Objectivity can be indicated by how well ‘skills and knowledge transfer to real-life’ or
'corresponds to real-life', how 'plausible the representation of reality' may seem and the extent to which the knowledge can be transferred to a 'personally relevant context'. Theories of reality attempt to identify 'fundamental principles'.

Generally less appreciated is the commitment to represent the subjective aspects of knowledge. This orientation to knowledge may be dominated by a personal aesthetic, and involve imaginative associations. There may be more freedom to create intentional distortions that appeal to the imagination. The emphasis may be experiencing fun or representing beliefs. Abstractions might focus more on identifying assumptions rather than fundamental principles.

For instructional design, the emphasis is usually on pre-planning. The final design may be dominated by specifications identified in the pre-planning stage. An instructional designer would expect to make most of their contribution during this stage. There would be minimal improvisation during the development phase.

However, software development rarely provides opportunity for extensive pre-planning. Typically, a game designer will create successive iterations until final design emerges. There may be no contribution in the pre-planning stage. It might be necessary to experiment with many options, discard much and do a complete rewrite. They may very well improvise most of the time. Infinite options must result in one design that works—providing a satisfying entertainment with adequate levels of challenge.

Each of the above phrases were included in the survey questions. On a scale of six, the respondent could indicate their level of agreement of disagreement with each
statement. Many of the questions were thought to be neutral to both perspectives and not likely to be favoured by one group.
Sampling Strategy

To identify respondents, this study used a snowball sampling strategy. In March of 1999, the researcher traveled to San Jose, California to attend the 12th annual Game Developer’s Conference. The official attendance for the five-day conference was 3159 attendees. Upon reviewing the conference handbook, the researcher identified approximately 20 potential respondents likely to have experience developing strategy simulation games. The researcher attended seminars or discussion round-tables with titles such as ‘Simulation Modeling’ or ‘Non-Combat Strategy Games’. After observing the seminar, participants were approached individually and asked to participate in the study. All of these people were asked to identify others who might wish to participate in the study. Approximately 30 people were approached and 22 people agreed to participate. This group of subjects constitutes a non-probability sample. At the time of this research, it was not possible to identify a large sample group of game designers and then randomly select subjects from within that group—thus presenting a challenge to external validity and limiting the opportunity to make generalizations.

Data Analysis

The interview data was analyzed for themes to determine the extent of general agreement between game designers. Specifically, did they agree about the need to design a specific closure for the simulation/game? Did they want the freedom to represent a subjective worldview? Were they uniformly committed to the iterative nature of software development? Did any other themes emerge? The analysis was then extended further to explore the potential disjunctions between game designers and
professor/instructors. As the system of higher education seeks to expand opportunities for online education, faculty may be asked/expected to collaborate with commercial developers. How do their perspectives differ? What issues will need to be negotiated? What evidence suggests remedies will be found?

The Research Question

To summarize, answers to the research question will attempt to identify disjunctions between commercial game designers and professor/instructors who are typical of existing institutions of higher education. A disjunction may exist if game designers prefer to design games with a specific closure. The pilot study interview indicated that professor/instructors would prefer a game with an open exploration where the end-user explores various trade-offs and does not easily reach a satisfying conclusion. A disjunction may exist if game designers prefer the freedom to represent their worldview based solely on their subjective notion of reality. It is presumed that professor/instructors will only be satisfied with the instructional potential of a simulation/game if the game reflects some standard of rigour with regard to objective analysis. A disjunction may exist if game designers report a high tolerance for the iterative nature of design. It is presumed that instructional designers prefer to emphasize pre-planning—once designed the teaching materials are then implemented with minimal fine-tuning. The design of a typical computer game may involve radical restructuring through several iterations over a two-year period before the final design emerges. Software development fosters an organizational culture which is very different from that of higher education. A disjunction may arise because the differences are too great.
The first two sections of the survey asked questions about learner outcomes and identifying the priority status of design characteristics. These questions were intended to identify the potential for disjunction based on: 1) open vs. closed, and 2) objective vs. subjective. The section regarding expectations of the development process were to illuminate the potential for disjunction based on pre-planning vs. iterative.
CHAPTER 4

RESULTS

Identifying Subjects for the Study

Twenty-two game designers of home entertainment products were identified, then surveyed and interviewed. Approximately half the interviews were completed during the week of the conference. The survey was completed by the respondent and the interview conducted immediately afterward. A few took the survey, completed it when they had some free time and then arranged to meet with me a day or two later to participate in the interview. The remaining half of the respondents took the survey home with them, returned it by mail to me and then a follow-up interview (by telephone) occurred several weeks (and some cases several months) later.

Survey/Interview Methodology

While the survey offers quantitative data for the purpose of analysis, it was intended primarily to set the stage for the qualitative follow-up interview. At least half the respondents were interviewed immediately afterward, allowing the opportunity to observe them while they completed the survey. Respondents were not asked to provide definitions or be familiar with terms. Rather these terms and definitions were lifted from the scholarly literature and presented to respondents in written form on the survey. While completing the survey, some respondents were observed pointing to a question, smiling and saying, “We were just talking about this last week.” No one asked for clarification of the meaning of a question while they were completing the survey. A few respondents (3) left a few questions (each > 5) unanswered. When queried afterwards about the
unanswered questions the respondents stated that they chose to leave them unanswered due to the contextual ambiguity. Respondents accepted the terminology. They appeared to have no difficulty understanding the survey and seemed familiar with the language and intent of the questions. The ambiguity arose because of the many different types of games (i.e. simulation game, strategy game, vehicle simulator). Several respondents indicated they would have chosen different answers depending on which type of game was being considered.

Interview questions were well understood, especially questions relating to open exploration/closure and the pre-planning/iterative design process. There were few requests for clarification or requests for examples. After being asked each question, many respondents gave detailed answers, rich with examples and industry references. The terminology of questions related to 'subjective versus objective representation' required some clarification. Most respondents accepted the 'addictions/obsessive compulsive' question with good humour. Many of these home entertainment game designers were somewhat disoriented by the sudden shift to questions about teaching/learning. Many appeared to be most familiar with the entertainment but not the education software industry. Without clearly identifying the potential problems of collaboration between professor/instructors and game designers, the interviews nevertheless tried to extract possible remedies. Many respondents asked for clarification. In providing clarification, I frequently described a plausible scenario where faculty/instructors and game designers may be collaborating in the future development of online education. After potential for future collaboration, the respondents often gave indications that this particular scenario had dubious prospects (i.e. due to the cost of
development and the commercial need for profit). Nevertheless, the pilot-study had yielded one possible remedy—the need for all members of the development team to ‘buy-in’ to the vision. This remedy was presented to all respondents. Most had definite views of this potential remedy.

Most respondents (19) were enthusiastic and seemed satisfied with their contribution. Three were less than enthusiastic and/or seemed impatient with the process. The respondents seemed articulate, speaking quickly and providing many references to other games as a kind of verbal short-hand. No one appeared overwhelmed by the survey or follow-up questions. Therefore, I believe the survey instrument and follow-up protocol served as an adequate tool to explore these design issues.

**Organization of Survey**

The survey was organized into six sections:

i) preferred definitions of a simulation/game (3 questions),

ii) intended end-user outcomes (EUO) - 31 questions,

iii) design priorities (DP)-14 questions,

iv) design contributions of the respondent (DCON) - 23 questions,

v) expectations of the development process (DPROC) - 13 questions, and

vi) demographic information (DEMO) -10 items.

Therefore each respondent could have chosen to answer a total of 94 items on the survey.

The follow-up interview was intended to solicit responses regarding:

a) General comments about the validity of the survey.

b) Exploration of the potential areas of disjunction:
i) End-User Outcomes: specific closure vs. open exploration

ii) Representing Knowledge: subjective vs. objective

iii) Development Emphasis: pre-planning vs. iterative.

c) General views on teaching and learning.

d) Potential remedies for future collaboration between game designers and faculty/instructors.

Survey Questions:

A fair representation of design issues or did they barely touch the surface?

The game designers found the instrument to be problematic but the survey was generally considered to be 'a fair representation of design issues', as reported by ten of the respondents. Six subjects reported that it 'touched the surface of design issues'. Two subjects felt 'it poorly touched the surface' and were not able to suggest additional or alternative questions that should have been asked. The other four respondents could not recall the details of the survey due to the time lag between interview and survey completion. The most frequent source of confusion was the delineation between open exploration and a specific closure. A respondent would answer some questions in the context of open exploration while others questions would be answered in the context of designing for a specific closure. One respondent suggested the only way to eliminate the confusion would be to complete two surveys: one for open exploration and the other for a specific closure.

Almost every respondent emphasized (over and over again) that the most important contextual issue was the need for the products to be commercially successful.
No part of the survey reflected commercial concerns and this is probably the most significant source of challenge to the validity of the survey.

**Qualitative Analysis Summary: Follow-up Interviews**

Most interview responses indicated that designer/instructor disjunctions will exist along three dimensions. These results also indicate that design issues identified several decades ago are still relevant.

The interview responses are summarized in Figure 1 and Table 1. As anticipated, the majority favoured designing for a specific closure, representing subjective knowledge and tolerating an iterative development process. A minority of designers were committed to representing objective knowledge and some desired a greater emphasis on pre-planning. However, game designers reported a significant willingness to accommodate the perspectives of professor/instructors. These results were not anticipated.

**Table 1: Game Designer Preferences For Four Design Attributes**

<table>
<thead>
<tr>
<th>Design Attributes</th>
<th>(n=22)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Desired End-User Outcomes:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Closure</td>
<td>12</td>
<td>54%</td>
</tr>
<tr>
<td>Both</td>
<td>3</td>
<td>13%</td>
</tr>
<tr>
<td>Open Exploration</td>
<td>7</td>
<td>31%</td>
</tr>
<tr>
<td><strong>2. Representing Knowledge:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subjective</td>
<td>9</td>
<td>40%</td>
</tr>
<tr>
<td>Both</td>
<td>8</td>
<td>36%</td>
</tr>
<tr>
<td>Objective</td>
<td>5</td>
<td>22%</td>
</tr>
<tr>
<td><strong>3. Development Emphasis:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iterative</td>
<td>11</td>
<td>50%</td>
</tr>
<tr>
<td>Both</td>
<td>6</td>
<td>27%</td>
</tr>
<tr>
<td>Pre-planning</td>
<td>5</td>
<td>22%</td>
</tr>
<tr>
<td><strong>4. Potential Remedy: ‘Buying-in’ to the vision:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>13</td>
<td>59%</td>
</tr>
<tr>
<td>Don’t know</td>
<td>3</td>
<td>13%</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>27%</td>
</tr>
</tbody>
</table>
While half of the designers favoured a specific closure, the other half favoured open exploration, or were able to accommodate both design goals. Thirteen of the respondents agreed with the pilot-study, that disjunctions could be remedied by all parties 'buying-in' to the same vision from the start of the project. However, six respondents were emphatic that 'buying-in from the beginning' was not necessary. This result was also not anticipated. The results can also be representing graphically as the three dimensions of a cube (see Figure 1). The horizontal dimension of 'end-user outcomes' represents the largest group favouring a specific closure. The vertical dimension,

**Figure 1: Number of Interviews Arranged on Three Variables**

*Design and Development of Computer Simulation Games*

The perspectives of 22 home entertainment game designers across three dimensions:
- End-user outcomes...Open exploration versus a specific closure
- Development emphasis...Pre-planning versus iterative
- Knowledge representations...Subjective versus objective
developmental emphasis, indicates the second largest group that reported a high tolerance for the iterative nature of design. The third dimension, knowledge representations, indicates the third largest area of agreement, the need for freedom to explore subjective representations of knowledge.

Commercial game designers had a non-trivial commitment to represent objective knowledge. Five designers indicated a preference for an emphasis on objective information while eight were committed to both (objective and subjective representations). Most were willing to design for open exploration but required to design for specific closure in order for their products to meet demands of the market. Five designers wanted to emphasize pre-planning because they had previously experienced chaotic development efforts where there was no pre-planning. Their preference for pre-planning was intended to prevent the occurrence of problems. When presented with a possible remedy to the professor/instructor disjunctions—the development team ‘buying-in’ to the same vision from the start—thirteen respondents indicated that it was necessary for the development team to ‘buy-in’. Six respondents indicated that ‘buying-in’ to the vision was not necessary. Excerpts from the interviews provide a more detailed picture of game designer perspectives.

End-User Outcome: Open Exploration

Seven game designers preferred to design an open exploration, where the end-user engages in continuous modification of variables and there is no final determination of winners and losers. Open exploration involves continuous play. Most simulation games allow the end-user to keep playing even after the win condition has been achieved.
However, once the win-condition has been achieved there may be less motivation to play the game.

I would tend to prefer the open-ended stuff. Simply because it gives you the opportunity to continue playing...I hate coming to the end of a game. Because that means it's over playing...I don't want to stop playing. My thing is, the more game-play the better. Respondent #22

The 'upside' of open exploration may indicate more time spent with the game product, a more satisfied customer and thus, a more commercially successful product.

I think the more creative people can feel in the environment the more...you can potentially have upside with them. If you have a linear experience like a story-based game and it starts playing and you get to the end and all of a sudden it's over...you are definitely limiting your upside...it might take them 10 or 20 hours to get through it, but once they've gotten through it there's no motivation to play it again. Whereas in an open ended game...there are a lot of people out there that will spend hundreds of hours playing 'Sim City' and had we designed it with a...beginning and a middle and an end, nobody would have played it more than 20 hours. So I don't like artificially limiting the upside unless its absolutely necessary, but at the same time you have to watch your downside which is that the game doesn't have enough goals or direction to get people even into it for any period of time. Respondent #17

The computer game ‘Sim-City’ was frequently mentioned as the primary example of a commercially successful open-exploration game. A few designers doubted that commercial success could be achieved with games that were exclusively open-exploration. Most designers preferred games with specific closure, or combined elements of closure and open-exploration.

End-User Outcome: Closure

Twelve game designers preferred to design games that intended a specific closure—concluded with a final determination of winners and losers. The commercial viability of these games was frequently mentioned.

It's the kind of game that I...typically have to build if I want to stay employed. Respondent #21

I think that's a preference in terms of the market place...I may design that way but it's always to the market. Respondent #15
Some designers disputed the dichotomy between closure and open-exploration, insisting that even an open-exploration had features of closure:

I think people favour closure. So as a designer I want to give them that. I think people understand that type of game. In Sim-City the closure is “You run out of money, you’re bankrupt, end-of-game.” And is that a real closure or is that just kind of happenstance-closure? [It’s] just like running out of time. I think people would rather say, “I’m competing with another city, the first to get a million people [wins].” Then they know what their goals are. Respondent #12

I think I favour closure...what my other answers were indicative of, is not forcing people down a particular path, but letting them choose their own direction within the confines of that. But then at the end of the day some type of climax is very rewarding. Like after a specific length of time, even if that length of time is very long, people want some type of closure...almost the opposite of having closure is to get bored with something and walk away from it. Respondent #11

Designing for closure is intended to appeal to those end-users who like to experience ‘resolution’, ‘a determination of results’ and ‘like to feel they have accomplished something’:

I think as a designer but also as a player, those are the type of games that I prefer. Something that, there may be an open exploration to it, it may have an end but I do prefer to have some type of resolution that you can come to, where when the game is finished you can say that you’ve actually accomplished something. Respondent #5

Obviously entertainment is critical, [players] want to be entertained and that generally involves having some drama, conflict and narrative. And that in itself leads into having a determination of results. Respondent #13

In addition to ‘achievement’, a satisfactory design should include multiple win-states to allow the end-user some opportunity to choose their own goals.

The one I most recently worked on was primarily a closed end game. There was for each...a set of scenarios where you were trying to achieve different goals within the railroad industry and each one of those had a finite winning condition, actually three levels of winning conditions. However, in any case whether [or not] you achieve those conditions, you had the option to continue and play on afterwards. Just build your railroad and go on. Respondent #7

You could have multiple win-states, and thereby allow the player to choose how they want to win....There’s a lot of satisfaction with achieving goals. Especially goals that you set for yourself. And I think there’s greater satisfaction in being allowed to achieve those goals in any way that you can imagine. You try different things and find out what works for you. Respondent #14

One of the respondents was a contract trainer to the U.S. military. He was more familiar with the adult education aspects of computer simulation games. As a consultant to the
U.S. military, he offered a three-day workshop to senior officers so that they could make informed decisions about purchasing simulation technology. He was also an avid player of home entertainment products. He referred to the difference between the experiential learning offered by the simulation and the transmission-mode learning offered by a debriefing session. He suggested that end-users were more likely to remember the 'intense' experience of the simulation and less likely to remember the 'tame' experience of the debriefing.

One of the things I feel... is that if you build a good simulation, it's a very personal and it could be even an intense experience. And so what you really learn and remember from that comes from the experience of doing it. And then there's a thing after that where you call it review or in the military we call it after-action review, analysis... Right now that is such a tame experience it's like putting up charts and bar graphs... you are totally not immersed in that... I think the learning that comes out of the after-part is going to be much less memorable and much less. It'll have a less guiding effect on your later behaviour than the actual interact thing. Respondent#2

The intensity of the simulation is often provided by the 'kill' consequence. The need to avoid death is a common focus of closure in both military simulations and home entertainment computer games. Another feature of closure is to be more prosperous than other virtual (computer-generated) competitors, or align your strategy with high-minded goals such as 'preserving the natural environment' (*Alpha Centauri*) or 'not conquering the indigenous people' (*Colonization*), and then determine if you can win the game on these terms.

The 'kill' consequence is often managed in an artificial manner by the end-user. A common strategy when learning to play a computer game is to save the game-state before making a risky move. If, after the risky move, the computer provides a less-than-optimal consequence, the end-user need only quit the current game, then revert to the saved game and choose a different strategy. It is a matter of debate as to whether this type of intervention diminishes the intensity of the simulation experience. If end-users
were not permitted to exercise this option they might come to resemble 'discouraged-learners' and thus stop trying. The 'intensity' of a simulation experience may be just another term for the frequently reported motivational effects observed in players of simulation games (Cherryholmes, 1966; Lee & O'Leary, 1971; Braskamp & Hodgetts, 1971; Druckman, 1971; Shubik & Brewer; 1972).

**End-User Outcome: Both Open and Closed**

Three game designers wanted the option of pursuing both open and closed aspects of a design.

The ideal game would have both where there's an open-ended structure that can be divided into scenarios. Respondent #4

One respondent resisted the dichotomy of closure versus open-exploration by suggesting that another distinction was more appropriate—between game, puzzle and toy:

I separate game from toy. A toy is something you play with. A game is something in which there is a conflict with an active entity. And a puzzle is where there is still a goal. So a toy has no goal, games and puzzles have goals and the difference between a game and a puzzle is the game has an active entity, actively opposing your goals. As such an open-ended thing is not a game. It is a toy. *Sim City* is a toy to me. *Civilization* is a game. Respondent #19

This respondent is correct—in *Sim-City* there is no active agent opposing your goals. This 'active agent in opposition' could be another term for closure. The active agent in opposition is usually a computer-generated competitor. In *Civilization*, there are other competing civilizations which are generated by the software program. However, other respondents would disagree. They suggested that goals do exist in *Sim-City* such as, 'create conditions for your population to grow' or 'not run out of money'. There are certainly many implicit goals such as 'developing infra-structure is desirable' or 'limit taxes to keep citizens happy'.

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The debate (and confusion) about issues of designing for closure versus open-exploration is evident in the scholarly literature. It is appropriate that this tension also emerged as a feature of the interview data in this study.

Knowledge Representation: Subjective

Nine game designers indicated their commitment to representing subjective knowledge. Four respondents referred to the emotional quality of the experience:

I prefer subjectivity. Really putting the person in the visceral experience of that role.....I think you should base your model on a real-world model and then you should identify in that, “What are the subjective viewpoints that make sense?” Respondent #10

Getting emotional buy-in from the player is the most important thing we can do. It’s the hardest thing to do but defined the way you’re speaking, I think subjectivity is something we try to do as an industry definitely because anything they think that’s not fun they throw it out. And the real world tends not to be fun, that’s why we make games. Respondent #4

If I’m in the entertainment space, I’m much more concerned with subjective feel. I don’t care that the model is accurate, I care that the model gives the feeling of accuracy, or the feelings and emotions of what I’m trying to model and communicate. When I’m doing stuff for the military it’s the opposite end. I have to be objective, it has to be able to undergo analysis and verification. Respondent #19

In the sense of entertainment...I try to avoid any plan. It’s hard if you’re doing realistic games but even then its got to be fun. So realism takes a back seat to a pleasant, and enjoyable experience.... All it teaches you is what the game designer thinks.... There is learning but what you’re learning is to play the simulation. Respondent #3

Two other respondents referred to the organization of the team during the development process, using the terms ‘framework’ and ‘guidelines’. Respondent #6 suggested that a team of designers needed the freedom to work within the guidelines:

I tend to give guidelines to my team that is designing and then give them a lot of latitude within those guidelines. Like I will tell them, “We are designing a vampire game for girls ages 14 and up....here are our books that we’re basing it on....we need a protagonist, a female protagonist. She needs this. This is our basic theme. Our thesis for this type of a game...And we work together and develop from there. Respondent #6

Respondent #1 referred to the cognitive engagement of the end-user and the opportunity to evaluate relationships between the various game elements:
I think the game should provide the framework and I should be able to hang my own little thoughts and patterns about the relationships between them myself. There needs to be some justification about why if you turn this dial up on these things, [why these things] happen but I'm perfectly capable of supplying the logic for that myself. And to me that adds a little bit of excitement to the, "Yes I've discovered something about the system." And the thrill is coming up with a theory to explain why that's the case. And that would actually be the part of game design that I like too. Respondent #1

The opportunity to make decisions based on emotions and an artistic sensibility support the game designer's commitment to represent subjective knowledge. They want the freedom to make choices based on their assessment of what is fun.

**Knowledge Representation: Objective**

Five game designers indicated their commitment for representing objective knowledge but the tension of representing subjectivity was still evident in their comments. The tension was especially evident in the desire to intentionally distort objective information in order to emphasize a certain aspect of the data abstraction.

I'm trying to keep as much of my bias out of it as possible and be as much a neutral observer as I can. But at the same time I'm not trying to simulate reality...I'm trying to do a caricature of reality to the point sometimes where...I will simulate something the way people expect it to work even if it's not the way it really works to match expectations depending on how on what thing I want them to really focus on. So...my thought was that I will take as objective view of reality and then I will distort it purposely but I will try to distort it not based on my subjective...impressions but more in terms of I want them to really notice this and not dwell so much on that. I want them to really notice the traffic on the roads and not notice think so much about the water in the pipes, or whatever...sort of the way a film-maker controls the movements of the camera so that the viewer really notices that door on the back but the coffee table is totally irrelevant so the coffee table is just totally incidental to the scene. So in fact I'm not trying to do a representation of my subjective perspective and I'm not trying to do an objective representation of the system.

Respondent #17

Respondent #18 agreed with representing objectivity of a military flight simulation/game, but wrote on the survey. "I try to remember that game play is the most important issue, create compelling illusions not realistic simulation". In the interview he differentiated between objective information and realistic information. To make the illusion
compelling it is necessary to ignore those parts of the reality where nothing much is
happening:

It's an interesting business because...spending resources, to create something completely realistic
ever ends up backfiring. It ends up being too complicated. And as realistic as a product like
'Flight Sim' is, even 'Combat Flight Sim', you have to cut corners in many, many areas. And
another very valid point is that realism is boring. If in the 'Combat Flight Sim' most [real life]
pilots would fly 56 missions and never see the enemy ...maybe [have] one encounter during that
time and ...we try to simulate that [encounter] on every mission. Respondent #18

In this context, subjective representation was interpreted by the respondents to mean
'making decisions about the level of data abstraction'. The designer needed to make
decisions about those features of the objective model that were sufficiently interesting.

Knowledge Representation: Both Subjective and Objective

Eight game designers indicated their commitment to representing both subjective and
objective knowledge. One respondent expressed her frustration with the level of detailed
objective information that is often modelled in simulation/games. In addition, she wants
to make meaningful decisions, and the relevance of the detailed information is not always
apparent:

I really don’t care...if the temperature falls by two degrees. If [that] is going to affect the
trajectory of my bullet, I really don’t care...I don’t want to have to think about that...I want to be
able to do some long term goal [planning], and then execute those...plans. And...do it in a
manner that gives me the result that I want. I don’t want to have to worry about those nit picky
details. ...I just sometimes think that they load it up with too much detail...some detail is
good...there is certain things that you’re going to want the detailed information... However when
it becomes burdensome...You’re going to confuse the player and then it becomes too hard to
concentrate on all those minor details...when you’re doing this long term goal planning.
Respondent #22

Most of the descriptive answers were attempts to describe the designer’s commitment to
objective knowledge and concurrent willingness to defer to a “need to make it fun” (see
Appendix H for more interview excerpts):

Its easier for me, as a player and as a designer to design around something real...[e.g.] railroads,
rather than something completely bizarre...space aliens from Mars. Although that’s a significant
sector of the market. I...lean towards having a historical basis and I will try within reason to frame a game within that historical basis, as reasonable accurately as possible. However, ultimately it comes down to fun, and anytime there’s a sacrifice made, anytime there’s a choice to be made between, kind of cheating it and going with the history, I’ll almost universally go in favour of what’s most fun for a game player....There are a few areas where the gaming market is very, very well-educated, and you cannot cheat, so to speak, at all, or they’ll catch you and you’ll hear about it. With the World War II game, that was more so the case. I think there’s a harder core following of World War, of military issues than there was of railroad issues. And we did fudge some things and got called to the carpet on it by some of the public. Respondent #7

This level of commitment towards representing objective information was not expected within the group of home entertainment game designers. These responses suggest that not only is there a desire on the part of the designer to represent objective knowledge, but there is also a consumer demand for objective knowledge. The need to make a game fun could be related to the difficulty level. If the experience is too difficult the end-user will be dissatisfied with the experience. Designing for fun accommodates the motivation of the end-user and allows them to continue to access the experience.

**Development Emphasis: Pre-planning**

Five game designers indicated a preference for emphasizing the pre-planning phase of the design process. Writing the ‘design document’ is the primary emphasis of the pre-planning stage.

The ideal is a designer comes up with the design document, and then a team of programmers and artists, led by a producer, combine and execute that design. That’s the perfect world. The design is rarely flawless, things change... the way you can do things changes, so there is control of the process down the line. Ninety percent of it right from the beginning would be lovely to attain but anything less than 75% done right up front and you’re brooking disaster. Respondent #4

In practical terms, software development often allows little opportunity for pre-planning. Several respondents indicated a *preference* for more emphasis on pre-planning but their experience in the industry suggested a high tolerance for the iterative nature of software development.
I've done a lot of programming where it's jump right in there. And it doesn't necessarily work that bad but the more you understand about simulations versus producing software, the more you realize that you're trying to build...a cohesive designed system that works end-to-end, that's complete. And the more you realize you can't do that by jumping in. Respondent #2

With my own personality...I like to have everything planned and laid out. Also being an experienced designer, in the industry I've seen far too many things just thrown together at the last minute, or five different aspects of a project go in different directions suddenly forced to tie together in the end and then throwing something out the door. Respondent #8

I'm someone who believes in getting as much of the design done up front. But then knowing that when you're in the process you're going to uncover things that you didn't anticipate. So... I don't believe in just jumping in... starting to build it without doing a lot of design up front. But like I said, the reality is you end up doing a lot of iterative development but its good if you can do most of your design up front. Respondent #10

It may be more appropriate to consider the design document as a marketing tool to attract financial investment rather than a stage of pre-planning. The design document can be analogous to a story treatment in preparation for developing a screenplay. The design document could be anywhere from 10 to 300 pages. Usually it is about 50 pages. If there is sufficient interest in the design document it is then referred to computer programmers, graphic artists, audio artists and other specialists who must then prepare the technical specifications which flesh out the details mentioned in the design document. Once the technical specifications have been completed, the company will decide whether or not to proceed with development.

**Development Emphasis: Tolerance for the Iterative Design Process**

Eleven game designers indicated a preference for a tolerance for the iterative phase of the design process. It is possible that a 300-page design document will be prepared and that no one on the development team will ever refer to it.

We had [a] two [or] three-hundred page design document the day I started, and no one looked at it after that. We had design documents written from hand without referring back to the design document because things come up. ‘Oh, we don’t have time for this, we don’t have time for that. Let’s make it simpler. We don’t need that feature anymore, we need this new feature.’ So you need something, a thematic document that gets the point across. ‘This is what we want to accomplish. Here’s how we see we can do it.’ Totally thought out and planned. So we see ‘Oh
there is a closure in this game. It’s an open-ended architecture. ’...All the technical and game play design things are nice to have in that, so someone coming onto the team... knows what we’re trying to accomplish. But it doesn’t work on an eighteen month cycle that every single letter is going to stay there and print throughout the cycle. Respondent #12

Iterative design may be a response to a lack of pre-planning:

The real problem is that most people specify whacking big systems to start with without really understanding the implications. Start going down the road it’s ‘Oh my god, what...[have] we done?’ and then they’re screwed, particularly if they took a whole lot of time up front. I think setting the general framework and architecture up front, what the system’s goals are and roughly how you are going to go about them and iteratively improving that architecture as you learn more about the system and its characteristics, but it has to be channelling back the knowledge into the overall system architecture. Respondent #1

Some designers acknowledged the usefulness of pre-planning but they were primarily committed to iterative design:

I think if you go with too much pre-planning, you become rigid. A formal structure is good in the beginning. You do want to lay down some strong groundwork... You don’t want to have your designers running off in 50 different directions. However if you create a design in the beginning and you say this is all we’re going to do, then you limit yourself... If somebody comes up with a really great idea in midstream, but it requires a huge change in the design, and you simply say no, well you may have lost a particularly great feature that would have made the game outstanding as opposed to just good. So then I think that the more flexible you are, the better. But you do always want to have some sort of groundwork in place, like a guideline to follow. Respondent #22

Every designer wants that because they always want the right to change their minds. Obviously that can be legitimate at some point. You’ll be testing something and it just didn’t work out the way you thought it would... pre-planning and pre-production are essential. You have to have those. And the more rigorous that process is the better the end product will be. But you also need to work in a tolerance for some iterative design changes. Respondent #13

Iterative design is necessary in order to ensure a product will be fun (see Appendix H for more interview excerpts):

One of the problems the games industry has traditionally had is not enough pre-planning, we just ‘Hey lets go make this.’ The problem is that our goal is fun. So you can do all the pre-planning you want. If when you get that part of it done, you realize it isn’t enjoyable, then you know you lose. So you need iterative design because you need to figure out what is enjoyable and what isn’t. And that’s the number one thing. Its got to be fun. If it isn’t you’ve missed the point completely. And that’s why iterative design is so crucial. On the hand you need pre-planning and pre-development, because if you don’t know where you’re going, you’re not going to get close enough. You need a target but you need to be able to make corrections when you realize this is good, this isn’t good, this is bad, this is better. Again our goal isn’t modelling reality, our goal is to create a pleasant experience for people. Respondent #3
The instinct for ‘tuning’ the ‘balance’ of a game would be the hallmark of experienced designers. Creativity and commercial success are supported by a commitment to the iterative nature of design.

I would be really surprised if any of the real veteran designers would say, “Why, yes, a perfectly balanced game emerges from my brain on the first try.” What happens is if you get a... good game topic, and a good game mechanic and it gets you in the ball park, and then what separates... the Syd Meiers from... the routine people is how well can they tune, what are their instincts for tuning it. So it isn’t just tuned for their personal pleasure but its tuned so that if hundreds of thousands of millions of people play, it ends up being really fun and the trade offs feel good. And... the victories are a close call and the defeats are by a hair, and if you do something really dumb you get a really bad result, and if you think of something brilliant, it can really reward you. But you are always involved. That’s why I favour the iterative process. It was a long time ago when we could do games, simply where we got it... right on the first try. And even the old 4K cartridges in the early ‘80s... tuning was so much a part of it. Respondent #21

Definitely... That’s both empirical and gut-feel again... I can name just some games that I’m familiar with how the development process went. I can name a whole bunch of hit games that were developed iteratively. I don’t know of a single one that was developed totally with front-end design... You can certainly design a game... just with doing all the design up front, but I’ve never seen a hit game developed that way. Respondent #17

I think there is nothing as stimulating to creativity as seeing what you’ve created, so the iterative is... innately a happier beast. Respondent #9

Development Emphasis: Both Pre-planning and Iterative

Six game designers indicated a preference for both pre-planning and a tolerance for the iterative phase of the design process. Pre-planning is seen as one opportunity to avoid problems during the development process:

Regularly I find myself saying “Boy if they had just thought about this a little bit more in advance we would be in much better shape.” So... there’s something to be said about being able to do things on the fly and keep up, but pre-planning can go a long way to even recognising what may need to be done... while your building it as opposed to thought ahead of.... I think a game design document would be a very, very, good thing.... It’s not something that you can expect to be written in stone, things will come up, new technology will come out, a competitor’s product will come out that you’ll need to be able to compete with. Changes will have to be made, but if you have that solid document then everybody on the team, whether they’ve been there from the beginning to just newly come on board, can go back to the original document and see the direction that the project is trying to go and know what needs what’s, what has been thought about before and what’s been ruled out, what’s in... Being able to go back and find a real clear lead on the direction the project is heading from the design document. Respondent #5

I’m definitely all for pre-planning and I think its very important but I’m a believer in only doing it to a certain extent, because I do believe the iterative process will take over... No matter how much you plan ahead we cannot plan for interactive pitfalls that come up during the development of a
game. I’ve seen it happen. But I’ve also…seen both sides. I’ve seen no planning at all and its been a disaster. And I’ve seen…tons and tons of planning where everything was storyboarded out, and it did go off very very smoothly. Respondent #16

Its more and more understood that a lot of detailed pre-planning is worthwhile and desirable; its just very hard to do…I think a lot of the history of game software development has been typified by the small group or the single person doing it on their own…feeling their way through it. I don’t know of anybody of the old school of designers that wrote out detailed design documents about what we’re going to do. But now that products have gotten that much harder to do and require larger teams and bigger budgets and so on, it’s seen that ‘Well you can’t afford to redesign the game every six months until you think you’ve got it right.’ And so, I think in the future…its tending toward much more pre-planning. There’s certainly a place for that iterative process but now I think it’s being viewed more as from product to product rather than within a single product. Respondent #14

A commitment to both pre-planning and the iterative nature of design can also support creativity.

Yes. I strongly believe in both. You have to do the planning, you have to [do] the iterative aspects of it because especially in the field of entertainment you are trying to communicate emotion. And…you have to feel the emotion coming from the work and then feed it back in. Just like if I’m doing a painting, I can plan a painting and can do sketches and so on. But [in] the actual [creation of] that work I have to feel the texture and see the colours on the canvas, and that feedback of the colours on the canvas is an important aspect of creating it. In the same way creating a game entertainment that is a necessary aspect. Respondent #19.

I view [the] design process as…a lot of sculptors talk[ing] about art…You have this big marble slab and you chip away and chip away, until there’s something nice there. And it’s a lot easier to take away things than it is to add things on to it. But then if something doesn’t work…(we always talk about ‘killing our babies’)…you have to let it go really quickly and get on with it. Respondent #11

Most designers have developed their skills in environments that allowed for only iterative design. Over the last 20 years, game products have become more complex. These game products now require more resources and larger development teams. Pre-planning (in the form of a prepared design document) tends to happen during the initial marketing phase, when the company is trying to decide whether or not to commit financial resources to development. Once the development has begun, game designers usually demonstrate both a commitment and a high tolerance for the iterative nature of design.
Possible Remedies to Disjunctions

Most of the respondents could not suggest any remedies. Most of the suggested remedies raised the issue of development costs and the commercially viability of learning-oriented products. This was deemed to be the biggest problem that needed solving. Most suggestions reiterated the need for the products to be highly motivating for the end-user and commercially successful for the developer (see Appendix H for more interview excerpts):

I think they'll have problems from perspectives more than they will goals...whenever I was in a classroom, whether I was the student or the instructor, part of the reason to do that was to present the students...different styles of teaching. Just standing up reading something off the chalkboard gets old....So as far as remedies I think that they need to admit and understand that they are on a stage to some respect and the obligation they have to these people, who are often paying their salaries, is to present the information in such a way that people will enjoy it, they'll be more receptive to it. From the other perspective, the computer game company is totally obsessed with money because it's very, very expensive to make a product. And you can lose a lot of money if you spend the money on the product, no one buys it. A lot of the money goes in at the front end and it's really hard to recoup. You can't sell a game, you can't make a game for $20,000 dollars and make 5000 copies of it. You pretty much now have to make games that cost millions of dollars to make and then sell hundreds of thousand to millions of copies. So, I think, someone from the game industry would have to step back from trying to addict people so much, and admit that...there can be other qualities to the entertainment, particularly as we try to differentiate games from say cinema or books or other forms of entertainment. One of things we could say is 'Hey, you are learning something here because it is interactive. Respondent #11

One respondent indicated that even fun may have to take a back seat to other considerations in order to support commercial values. For instance it may be necessary to develop the product based on a 3-D graphics platform, to create a favourable first impression with the consumer. This 3-D graphics platform uses the microprocessor more intensively and could slow down game-play thus decreasing the fun factor. If the game were developed with 2-dimensional graphics, the game play would be faster but the consumer might assume that the game is too old fashioned. The marketing of such a 2-D
game would then have to depend more on favourable reviews and word-of-mouth between consumers.

The primary problem is the thing driving commercial game designers is commercialism. So fun is not the most important thing, learning is not the most important thing, sales is the most important thing... Anything you can do to encourage sales regardless of its fun-factor and/or its education factor is immaterial to the commercial goals.... Production values are important. And it may not be fun... [or] have anything to do with the game play or how fun the game plays. It may have everything to do with first impression. Respondent #15

Other remedies to possible disjunctions between game designers and professor/instructors referred to the communication dynamics between members of the development team.

These responses emphasized recruiting team players, mutual respect, keeping an open mind and striking a balance between the two perspectives (see Appendix H for more interview excerpts):

I would say that the faculty and curriculum designers need to really make clear to the game designers what the goals are but not try to dictate how those goals are reached from the creative point of view. Because...knowing what the goals are is the curriculum’s expertise. Knowing [how to] design something that’s engaging and can reach those goals is the game designer’s goal and that’s their expertise. So I’d say each group respecting the other group’s area of expertise, and knowing what that is, and... understanding that that their own group is not good at, is the best way to remedy that. So mutual respect. In the computer industry, the software industry, like I’m in the enterprise consultant thing. And we do what we call ‘J.A.D.’ sessions which is ‘joint application development’ where the people who are going to be using the system, day to day, who were trying to actually accomplish their goals. Sit down at the very beginning with the designers of the system and they just... do creative brainstorming and hash things out. Respondent #10

The overwhelming tenor of these responses indicate that commercial values would establish the context for collaboration. The respondents indicated that these values would probably be the greatest source of dissonance between the two groups. Furthermore, their experience as game designers indicates that there is little opportunity to challenge these values.

**Possible Remedy: ‘Buying-in to the same vision’**

During the pilot-study, one respondent indicated that all team members should ‘buy-in to a common vision’ before beginning development of a game. All 22 game designers were asked whether or not they agreed with this possible remedy.
Remedy: “Yes” to buying-in to the vision.

When “buying-in to the vision from the beginning” was suggested a possible remedy, thirteen game designers said, “Yes.”

You gotta have a vision and if there’s one thing I’ve learned across all of the software failures I’ve been associated with, you gotta have a vision and you gotta stick to it. Doesn’t mean the vision can’t change but you got to have one and everyone’s got to buy into it. Respondent #1

You’ve got to have similar goal in mind before you can start. It’s…like agreeing on terms before you begin a debate…If you can’t agree on definitions then you can’t even converse. So you’ve got to have an agreement that we are going to build a piece of software that does ‘X’. And you got to agree on what ‘X’ is before you can begin. Respondent #6

I think all parties should agree before they begin. It just stops confusion. You have to have a vision of the end result before you start. And more people who can see that and understand it, the more effectively they will work together while seeking to attain that end result, that goal and that vision. So, I’d say definitely decide on that before you start. Respondent #13

A prominent concern is a design that ‘spirals off’ in other directions because it is difficult to change existing programming code to accommodate these new directions.

I think that having a single vision on a product or a project that you’re working on is very important for everybody involved. So as part of…the whole pre-planning pre-production cycle, you would need to make sure that that everybody was on the same page as far as what it is that’s trying to be made, where it is that you’re trying to go with the product that you’re working on. Because otherwise you tend to spiral off. And this person’s doing that, and this person’s doing that, and this whole department’s doing something different and it doesn’t come together. The end product is, you can…tell it is patchy. So absolutely the most important thing is to make sure that everybody’s got a shared vision on what you’re building. Respondent #5

You definitely want a plan. You definitely want to have something organized. You want have a distinct end-goal, a focus: what it is you want to provide and what it is you want to construct because without that you are going to be going in different directions all the time. Respondent #8

I think directing it from the beginning would be the best way to do it, so that there are no surprises along the way, because once we’ve coded a certain amount its impossible to go back. The content is easier to add in and out but if the content is central to the product, it’s not [easy to edit in and out]. So talking up front and going along with the process is very important. Respondent #4

Always have a clear vision when you start. Work out the vision first and then do the implementation. Always….Any product with an unclear vision wanders to its completion if it’s ever completed…Most of the time they aren’t completed. Respondent #15
Remedy: “No” to buying-in to the vision

When “buying-in to the vision from the beginning” was suggested as a possible remedy, six game designers said, “No.” Given the complexity, cost and challenges of software development, it was surprising that several very experienced designers indicated a significant commitment to be open to ‘discovering’ a vision as the team proceeded through the development process (see Appendix H for more interview excerpts):

You know in an ideal world you buy visions at the start but I think a lot times, people who left St. Louis for San Francisco had shared three sentences worth of agreement about why they were in the same wagon train. By the time they got to the Sierra Nevadas they had a much deeper vision of why they had this shared goal. In a perfect world we would all really understand it before we set out together. But in my experience, on projects, you interview each other to believe that you belong in the same wagon train and then you simply trust in each other, as people who can give and take, so that your visions stays together as you go. Respondent #21

Remedy: “Don’t know” about buying-in to the vision.

When “buying-in to the vision from the beginning” was suggested as a possible remedy, six game designers said, “I don’t know.” Again the context for collaboration would be established by commercial values. A successful collaboration would be more likely if it included an educator who embraced those commercial values and was able to communicate with other educators. However, the respondent was doubtful that this would be possible.

I think that depends on what area you’re going into in the education arena because I think the most resistance [will come from] the education arena. The entertainment arena is a business money-driven environment, if there’s an opportunity, they will be interested. Educators from my perspective are extremely close-minded. They made up their minds a long time ago. They need to be highly persuaded and they’re going to clearly be the hardest ones to get into this. And I think, maybe getting them at the beginning would definitely be the easy one. It’s very easy to say ‘No’ even to an existing product. If you’ve invested some of yourself in it, it’s much harder to say ‘No’. And there’s nothing that an educator likes more than to be consulted. So, I think that it’s probably the best way to go. Somehow I think the name of an educator associated with it, will assist it greatly in communicating to the other ones. I think the gaming industry is going to be dismissed outright without the assistance of an educator from the get-go. Respondent#9

Clearly there was little agreement on whether or not to buy-in to the same vision. Those respondents who were most in favour of not buying-in were also those respondents most
committed to the iterative nature of development process. The game-designers intend to 
discover their vision as they proceed through development. This intent is at odds with 
accepted practice for instructional designers. Educators are usually very focused on 
deciding objectives and then structuring the experience for learners. Their instructional 
design processes tend to follow this same emphasis. Any potential collaboration between 
the two groups may wish to explore this topic more fully.

Descriptions: Teaching and Learning

In discussing teaching and learning, game designers often referred to a form of 
implicit learning. Computer simulation games are usually designed to be played as soon 
as the software is loaded onto the computer. To play the game at the more difficult 
levels, a significant amount of information needs to be mastered. Marketing features and 
the 'need to have fun' receive primary consideration in the design and so it is not 
surprising that for game designers, end-user-learning receives secondary consideration as 
an outcome.

Many of the designers referred to the informal nature of learning with phrases 
such as: 'the extent to which people learn things is accidental', 'hide the education in the 
design', 'I've tried to teach in a sort of under the radar way', 'we stick learning in there as 
a byproduct', and 'you learn so much in a game by accident'. Others suggested that the 
learning was analogous to the biological process of osmosis. The following phrases were 
used: 'absorb the content along the way', 'pick it up through osmosis', 'really deep 
learning is done through osmosis', 'soaking up all the details through osmosis', and 
'sneaky education through osmosis'. Still others used more recognized terms to describe
the learning: ‘a process of experimenting’, ‘beyond the simple exploration, they’re thinking out the entertainment’, and ‘discovery is...kind of a key [to learning]’. Perhaps the most interesting term was ‘stealth’ learning. This terms suggests that the end-user may not even be conscious of what is being learned but will be enabled to employ the knowledge in some tactical way.

Implicit learning is usually a primary feature of an apprenticeship style of learning, where a mentor gives continual guidance to the learner thus providing feedback and facilitating an explicit awareness of the knowledge. In addition, the learner has joined a community of practice that provides further support for implicit learning. This community provides a rich context of informal cues which must be decoded by the learner. It may be useful to think of simulation games as providing a cognitive-apprenticeship (i.e. practical experience in decision making) operating within a ‘virtual’ context. The literature on situated learning, which includes concepts such as cognitive apprenticeships, provides a framework for analyzing various qualities of learning that relate to how people acquire new skills and become members of communities of practice (Lave & Wenger 1991; Greeno, 1997; Wolfson & Willinsky, 1998). The theory of situated learning argues that most learning is context-dependent and thus challenges the model of ‘exact’ (or symbolic) reasoning (Jonasson et al, 1995). The context serves as an ‘index’ or ‘map’ within which learning is socially negotiated—learning is conversation about the surrounding context. Interacting with the environment, formulating and testing hypothesis and reflecting on previous understandings are necessary in order to create a personal view of the world (Crotty, 1994). This model has emerged only recently and has not been widely accepted by the culture of higher education.
A ‘conversation’ between an end-user and simulation/game may involve hundreds, perhaps thousands of interactions. The purpose for both end-user and the artificial intelligence of the simulation/game, is to create an elaborate and increasingly difficult system from which hypotheses may be tested and reflected upon. This activity will be valued by educators who value the dynamic process of learning, emergent thinking and the personalized construction of meaning. In contrast, a disjunction is more likely to exist for those educators who value stable representations of objective knowledge, manipulation of symbols, and learning that is product-oriented.

The culture of higher education is the organizational feature that is the least amenable to change (Morgan, 1986). The political, bureaucratic and environmental structures may all induce change but cultural features of an organization are the most resistant. Therefore, possible disjunctions between game designers and professor/instructors may arise from the different assumptions of their respective cultures. The culture of higher education is organized to serve the conscientious-learner and resists accommodating knowledge based on anomalous phenomena. The culture of entertainment simulation/games is intended to serve the curious-learner and the complexity of simulation/games offers a knowledge-construction which creates the appeal of multiple anomalies. The differences between the two cultures can be described along these dimensions, and will form the basis for analysis and critique in the next chapter.
CHAPTER 5

SCHOLARLY ANALYSIS AND CRITIQUE

The differences between professor/instructors and game designers include: a) the decades of debate for scholarly knowledge versus months of development for a computer game, b) peer review from a community of scholars versus a software development team of 5 to 10 people, c) extensive peer review versus the search for one design that satisfies, and d) an orientation to social demand versus market demand (see Figure 2). These differences may represent a significant barrier to future collaboration. The willingness of online educators to pursue a market orientation and game designers to accommodate the construction of objective knowledge are the first cues that a collaboration may be possible.

**Figure 2: Differences between Professorial and Game Design Cultures**

- **Oriented to Social Demand**
  - Community of Scholars
  - Decades of Debate
  - Extensive Peer Review

- **Oriented to Market Demand**
  - Development Team: 5-10 People
  - Months of Development
  - Find One Design That Satisfies
Less obvious is the relationship between the two cultures—although each is distinct, there is an area of overlap (see Figure 3). Academia elevates a culture of critical analysis above curiosity, while computer simulation/games elevate curiosity above critique. The tendency to elevate one culture above another may be another source of disjunction between game designers and professor/instructors. While the disjunction may exist, an overlap between these two cultures can also be described. Each culture is committed to various degrees of open, fair, and independent mindedness, as well as an

Figure 3: Overlap Between Professorial and Game Design Cultures
attitude favouring inquiry. The need of game designers to enhance player motivation by distorting plausible scenarios suggests the extent to which they elevate curiosity above critique.

Simulation/games offer many features which appeal to the curious learner: complexity, surprise, novelty, incongruity, conflict and non-conformity. These same features resonate with and are characterized in Kuhn’s (1962) seminal work *The Structure of Scientific Revolutions*. While Kuhn’s examples are derived from the early history of physics, chemistry and astronomy, there is evidence that anomalies continue to be disparaged by academic culture (Jahn, 1989; Milton, 1994; Woodhouse, 1996; Sturrock, 1997; Jahn and Dunne, 1997; Bockris, 1999; Mack, 1999; Mallove, 2000). In recent decades, scholarly developments in history and sociology have called for a bridging of the gap between scientific expertise and public concerns, eventually leading to a democratization of science (Sarder 2000). The elevation of critical analysis assumes learners wish to be included in a ‘members-only knowledge club’. The elevation of curiosity assumes learners wish to be ‘invited to a knowledge party’. Both cultural assumptions are valid considerations for future implementations of higher education.

The willingness of academic culture to integrate understanding of anomalies might signal a corresponding convergence with a culture that elevates curiosity. As the momentum increases for the convergence of various technologies, the impetus for collaboration between game designers and professor/instructors may also increase. Future success may depend on the willingness of collaborators to accept the other’s cultural assumptions.
The Obvious Differences

Scholarly knowledge is constructed after peer review. Research is conducted, written and submitted to editors who forward the manuscript to reviewers. Revisions are suggested and the researcher rewrites the document. This activity occurs within a very hierarchical structure. Some disciplines have higher status than others. Some publications have higher status than others. Some researchers have higher status than others. For instance, theoretical knowledge may be more valued than applied knowledge. Before scholars even conceive a research project, they have already accepted many tacit understandings of their discipline and institution. Inter-disciplinary research is probably an option for only the most senior faculty. Junior faculty are advised to focus on research that builds on the current body of knowledge—the product of decades of debate. Furthermore, professor/instructors are expected to be circumspect in their presentation of knowledge. The object of research may be surveyed broadly or understood deeply, but breadth and depth probably cannot be achieved in the same instance. Teaching of this knowledge requires that all these values be conveyed to the student.

Software development is usually conducted by a small group of people over a few months. Their typical goal is to find one design that works and get it to market as soon as possible. Staff turnover can spell disaster for the development effort. Even with a stable staff, many projects are begun but never completed (the money runs out or the design changes direction too many times). When recruiting team members, technical skill is highly prized. The software industry often requires employees to work for long periods (60 to 80 hours per week) with little opportunity to secure a balance between their work and personal life. Conflict in the workplace is common. Burn-out of employees is also
common—many working themselves to a state of exhaustion then leaving the industry for an extended period to recuperate. In this environment, finding and building a consensus within the group is essential. The successful functioning of a small development team may depend more on charisma, harmonious communications and simple good luck. Objective understanding may be useful only to the extent it serves the consensus-building process. In the crucible of software development, the motto may well be “use whatever works—find one design that satisfies”. Marketing factors such as the need to ship by October 31st (for the Christmas shopping season) may be more important that how well the game represents objective knowledge. Furthermore, the goal of entertainment encourages game designers to choose ‘interesting’ rather than ‘important’ features. Whereas in academia, the ‘importance’ of knowledge takes priority over mere interest.

With two cultures that are so different, where does a possible commonality for teaching exist? Motivation-to-learn is one. One theory of motivation describes learners based on their different sources of motivation: achievement, sociability, curiosity and conscientiousness (Orbach, 1979). Computer simulation games invite learning through achievement and curiosity, while 10 to 20 percent of other learners—conscientious ones—report a high level of dissatisfaction with simulation/games. As previously stated, game designers have already indicated a willingness to conform to standards of achievement related to transmission of objective knowledge. More problematic however is the motivation-to-learn through curiosity. Designing for this attribute must be viewed as vital. Provoking curiosity may be the one thing computer simulation/games do best. Academia may elevate a culture of critical analysis above that of curiosity, in a way that
may be unacceptable to game designers. The differences between these two cultures may be the primary source of disjunction.

The Less Obvious Differences

Concepts of critical thinking within academic culture have been described (Bailin et al, 1999a; 1999b). The concepts include: a) judging intellectual products, b) established standards of adequacy, c) accepted strategies of deliberation, and d) a context of existing concepts, beliefs and values. These are the cultural features which probably elevate critical thinking above curiosity. However there is an area of overlap with the culture of curiosity. These 'habits of mind' include: a) open mindedness, b) fair mindedness, c) independent mindedness, and d) fostering an inquiring attitude (Bailin et al, 1999b). Professor/instructors and their students are guided by the habits which foster curiosity, but institutions of academic culture are primarily committed to more deliberative features of critical thinking.

The motivating effects of simulation/games may be intrinsically linked to curiosity. The early literature frequently reported enhanced motivation with this type of instruction (Cherryholmes, 1966; Braskamp and Hodgetts, 1971; Druckman, 1971; Lee and O’Leary, 1971; Shubik and Brewer, 1972). However, only one article conceptualized the dimensions of motivation (Orbach, 1979). This model of motivation which emphasizes the role of curiosity deserves a deeper exploration.
The Curious Learner

Commercial game developers must master many dimensions of human motivation, especially (given the complexity of simulation games) the motivation to learn. Often designers have nothing more to rely on than their own instinct-for-fun as it was developed when they were an avid game player. Designers must constantly ask—what makes the game fun to play? In general, the development of computer software is an iterative process—one program will be ‘built’ many times, each time incorporating new revisions. The design and development of a computer simulation game often depends on the designer’s sense of ‘tuning and balancing’ where:

The trade-offs in the game feel good, the victories are a close call and the defeats are by a hair, and if the end-user does something really dumb then there is a really bad result, and if end-user thinks of something brilliant, the game provides a big reward. Respondent #20

Therefore the development of a computer simulation game requires the designer to identify relevant features of human motivation.

Motivation to learn has been defined as both the need to and readiness to learn. When consumers buy a computer simulation game they are aware of a readiness to be entertained (i.e. diverted by interesting information and experiences), but are they aware of a need to learn? It is possible that computer simulation games fulfill a need to learn not normally met within the existing education system—the need to achieve victory, need to explore novel environments and feel social affiliation. Consumers do not think of simulation/games as learning because it does not correspond to their usual experience with learning. Rather, consumer conceptions of learning are probably dominated by their remembered experience of the education system.
A small percentage of learners (10-20%) consistently report a dislike for learning through simulation games (Orbach, 1979). These dissatisfied learners were placed in the category of ‘conscientious’ learner. With so much of the research reporting the motivational advantages of simulation/games, how is it possible that a learner would fail to realize these benefits? Motivating a conscientious-learner has three main characteristics: a) learning activities which are highly structured and well ordered, b) learning tasks which emphasize diligence and compliance more than original thinking, and c) constant evaluation and feedback from an authoritative figure. Does this sound familiar? To most ears this would be an apt description of learning offered by most institutions such as: corporations, military, churches, colleges and universities. Perhaps, our education system has been designed to serve ‘conscientious’ learners, ‘Curious’ learners might be better served by technologies such as simulation/games.

Conscientious learners seeking to demonstrate diligence, and compliance may be overwhelmed by an abundance of choice in simulation/games which are often highly structured but not well ordered. A simulation/game rarely rewards diligence. Furthermore, the learner may be suddenly immersed in a situation where they must make decisions without any prior preparation...without diligent study of the subjects. Original thinking, trial-and-error and blind guessing are often the only option. Another source of dissatisfaction is the absence of an authoritative figure and minimal opportunity for evaluation. External support comes only from other peers who may happen to be playing the game. For all the reasons listed above, conscientious learners report a high level of dissatisfaction with instruction via simulation/games designed for a classroom (Orbach, 1979). The literature does not report any findings related to computer simulation games.
Simulation/games may be most appealing to learners motivated by curiosity and achievement. Novelty and complexity are the two most important properties for those students motivated by curiosity. Typically the learner scans the environment for anomalies and, when discovered, these become a source of anxiety until they can be integrated into a more general framework. The characteristic of novelty is dominated by change and surprise. Complexity is dominated by incongruity and conflicting information. Conflicts cause doubt, which must then be resolved by further exploration and manipulation of the information. The curious learner is encouraged by an atmosphere which supports nonconformity.

These games also appeal to the achieving learner—people who like to succeed in a competition and to measure their status relative to other people. They like to take action and show initiative. The artificial intelligence of the computer game is primarily dedicated to providing ‘virtual’ competitors. The end-user may be competing against several civilizations, railroad companies or ideologies. The relative rankings of each faction will be available to the end-user throughout the game so they can measure their performance.

Finally, sociable learners express a need for affiliation—the need to find and maintain positive, friendly and gratifying personal relationships. Self-confidence and personal pace are the two most dominant attributes of the sociable learner. Typically they are intensely concerned about interpersonal relationships. Currently, computer simulation games are played mostly by one person and on a personal computer. The intrinsic design of the game supports affiliation in minimal ways only—the end-user may choose to identify with a certain faction or ideology and will play the game from the
perspective of that particular value system. As stated previously, the emergence of ‘massively multi-player’ environments holds the promise of more social interaction.

The conscientious learner may have an advantage over the others. Most instruction provided by existing institutions seems primarily designed for them while those people motivated by curiosity, achievement and affiliation may need to seek other contexts for learning. While achievement and affiliation can be experienced in many contexts, systems of education rarely elevate a culture of curiosity above critical analysis. Learners are encouraged to engage in analysis but the proscribed ‘strategies of deliberation’ are intended to limit their source knowledge to the peer review literature. Evidence for their arguments must be built on this foundation. Rarely do these limitations allow non-conformity which encourages the curious learner. If conscientious-learners are not motivated by simulation games, what is the likelihood that curious-learners are unmotivated by conventional instruction? One implication that future researchers may wish to explore is the idea that existing institutions are supporting a particular ideology which may be optimal for a one group of learners, while simulation/games may empower others to explore alternative ideologies which are optimal for them.

Emerging online organizations may need to position their product in the marketplace by providing education that is qualitatively different from conventional instruction. Current implementations of online education merely transfer existing metaphors (e.g., distance education and the graduate level seminar) to the Internet. These implementations fail to provide a compelling educational milieu when compared to conventional face-to-face instruction (Boshier, 2000). Furthermore, online education
tends to be chosen by non-traditional students who would not otherwise engage in higher education (Slaughter, 1998). For these reasons, there is some concern that many students will be influenced by market hyperbole and choose online education before realizing that conventional instruction offers better benefits. If commercial ventures believe they can design an educational product that offers different advantages (over face-to-face instruction), then they may wish to explore computer simulation/games. The search for 'different advantages' will bring into focus the possible disjunction remedies that might be fruitfully explored.

The curiosity of a learner is provoked by the discovery of anomalies. Once discovered, incongruities must be fully explored and integrated, otherwise the learner will continue to experience high levels of anxiety. Within scientific communities, research activities associated with anomalies have been a subject of continuing controversy. If a culture of curiosity is to be fully accommodated, educators may well ask, "How can professor/instructors teach students to appreciate (and respond to) anomalies when they themselves are constrained by a culture of critical analysis?" Kuhn (1962) proposed that adopting of a 'new' paradigm required discarding the 'old'. Previous knowledge must necessarily be re-interpreted within the framework of the new paradigm—for, Kuhn, there was no middle ground. He compared scientific revolutions to political ones suggesting each progressed through the same stages. In this conceptualization, anomalies are an ever-present source of tension which hold the potential to escalate crises when factions become highly polarized. Thus stakeholders in the academic culture maintain a network of commitments with the intention of avoiding these kind of crises. The
relationship of his analysis to the culture of curiosity will be more fully explored in the next section.

**Valuing Anomalies and Curiosity.**

As the various information technologies converge, it may become useful to recognize the value of curiosity and the consequent need to explore anomalies. Kuhn's (1962) analysis was the first to receive wide acceptance. His argument is still relevant today, especially to academics interested in anomalies research (Jahn, 1989; Milton, 1994; Woodhouse, 1996; Sturrock, 1997; Jahn and Dunne, 1997; Puthoff, 1999; Bockris, 1999; Mack, 1999; Mallove, 2000). Sarder (2000) has reviewed the historical developments in the sociology of science since the publication of Kuhn's *The Structure of Scientific Revolutions*, and concludes that 'science [must be brought] out of the laboratory and into public debate where all can take part in discussing its social, political and cultural ramifications' (p. 65). The mass distribution of computer simulation/games has the potential to empower members of the public to engage in debate with scientific experts. Simulation/games provide a 'community of situated practice' in which the skills and confidence can be developed.

Many scholars have alluded to the limitations of a scientific culture that places too much emphasis on critical thinking. Physicist and Nobel Laureate, Maxwell Planck, is remembered for his famous quote about the intellectual intransigence of senior members in the research community:

An important scientific innovation rarely makes its way by gradually winning over and converting its opponents. What does happen is that its opponents gradually die out, and that the growing generation is familiarized with the ideas from the beginning (Maxwell Planck, 1858-1947).
Kuhn (1962) emphasized the larger social context influencing habits, expectations and reputations of leading thinkers. His analyses directs attention to the same features which are so motivating for the curious learner—novelty, anomalies and complexity:

Normal science, for example often suppresses fundamental novelties because they are necessarily subversive of its basic commitments (p. 5).

Normal science does not aim at novelties of fact or theory and, when successful, finds none... Discovery commences with the awareness of anomaly, i.e., with the recognition that nature has somehow violated the paradigm-induced expectations that govern normal science. It then continues with a more or less expanded exploration of the area of anomaly. And it closes only when the paradigm theory has been adjusted so that the anomalous has become the expected (p. 52).

Kuhn defined an anomaly as a “violation of our expectation (p. xi)” and elaborated on the emergence of novelty, “In science... novelty emerges only with difficulty, manifested by resistance, against the background provided by expectation” (p. 64).

A prevailing paradigm may constrain research by avoiding complexity:

... one of the things a scientific community acquires with a paradigm is a criterion for choosing problems that, while the paradigm is taken for granted, can be assumed to have solutions. To a great extent these are the only problems that the community will admit as scientific or encourage its members to undertake... a paradigm can, for that matter, even insulate the community from those socially important problems that are not reducible to the puzzle form, because they cannot be stated in terms of the conceptual and instrumental tools that the paradigm supplies (Kuhn, 1962, p. 37).

His description of puzzle solving corresponds to the concept of critical thinking:

Turn now to another, more difficult, and more revealing aspect of the parallelism between puzzles and the problems of normal science. If it is to classify as a puzzle, a problem must be characterized by more than an assured solution. There must also be rules that limit both the nature of the acceptable solutions and the steps by which they are to be obtained (1962, p. 38).

He also described the vagaries of professional motivation where puzzles must be solved within the bounds of accepted rules:

A man [or woman] is attracted to science for all sorts of reasons. Among them are the desire to be useful, the excitement of exploring new territory, the hope of finding order, and the drive to test established knowledge.... nevertheless, the individual engaged on a normal research problem is almost never doing any one of these things. Once engaged, his/her motivation is of a rather different sort. What then challenges him [or her] is the conviction that, if only [s/]he is skillful enough, [s/]he will succeed in solving a puzzle that no one before has solved before or solved so well (1962, p. 38).
He defined the stages of a scientific revolution as follows: awareness of an anomaly, the gradual and simultaneous emergence of both observational and conceptual recognition, the new paradigm emerges often accompanied by resistance. The resistance of academics becomes more apparent as 'crises' escalate. Scientists may begin to lose faith and even consider alternatives but they refuse to renounce the paradigm that has led them into the crisis. The ‘revolution’ has the power of a cultural force that often goes beyond the scope of one individual or organization. The ‘assimilation’ of a new theory takes time. The characteristics of a scientific revolution describe the transition from normal to extraordinary research: anomalies challenge the existing paradigm, many theories emerge and compete (with a willingness to try anything), discontent is made explicit and subsequent debate centres around fundamentals. Finally, Kuhn asserted that evolution of scientific understanding and the history of paradigm changes were similar to the dynamics of political revolutions:

Political revolutions aim to change political institutions in ways that those institutions themselves prohibit... In increasing numbers individuals become increasingly estranged from political life and behave more and more eccentrically within it. Then, as the crisis deepens, many of these individuals commit themselves to some concrete proposal for the reconstruction of society in a new institutional framework. At that point the society is divided into competing camps or parties, one seeking to defend the old institutional constellation, the other seeking to institute some new one. And, once that polarization has occurred, political recourse fails... the parties to a revolutionary conflict must finally resort to the techniques of mass persuasion, often including force (1962, p. 92).

Kuhn challenged the myth of ‘scientist as hero’ and argued for a larger consideration of the social factors in the construction of knowledge paradigms. While he analyzed historical examples (e.g., Copernican astronomy, Newtonian physics and Lavoisier's ‘invention’ of oxygen combustion), it is important to note that his message resonates with contemporary researchers as well.
In contemporary times, academic culture continues to employ a variety of strategies that reinforce orthodoxy. These include the refusal to consider threshold effects, blacklisting publishers when so-called 'popular' science titles are published through academic divisions, as well as the marginalizing tactics of scientific censorship (Milton, 1996). Scientists who challenge prevailing orthodoxy have a limited number of options which include mimicking science, aiming at lower status publishers, enlisting patrons, seeking a different audience, exposing suppression of dissent, or building a social movement (Martin, 1998). Other researchers have sought to elevate the subjective views of science (Jahn & Dunne, 1997), while another argues for an increased valuing of creativity and curiosity, in conjunction with critical thinking (Sturrock, 1997).

Dissatisfied with the opportunities to explore anomalous phenomena, one group has formed their own society and publication, *The Journal of Scientific Exploration*. The membership consists primarily of astronomers, physicists and engineers. One of the founders is Robert Jahn, a former head of the Princeton Engineering Department. He and his colleague Brenda Dunne, suggested the need to recognize the complementary nature of the subjective and objective traditions:

> Any neo-subjective science, while retaining the logical rigor, empirical/theoretical dialogue, and cultural purpose of its rigidly objective predecessor, would have the following requirements: acknowledgment of a proactive role for human consciousness; more explicit and profound use of interdisciplinary metaphors; more generous interpretations of measurability, replicability, and resonance; a reduction of ontological aspirations; and an overarching teleological causality. Most importantly, the subjective and objective aspects of this holistic science would have to stand in mutually respectful and constructive complementarity to one another if the composite discipline were to fulfill itself and its role in society (Jahn & Dunne, 1997, p. 1).

Each discipline has an established paradigm of measurement and has identified anomalies that continue to defy established theoretical models. Others have described the
controversy and ‘messiness’ that tends to accompany anomalies research (Bauer, 1987, 1988; Jahn, 1986). The conventions of scientific discourse constrain all research pursuits but are particularly problematic when investigating anomalies:

Within science, disputes are to some degree constrained by the existence of a widely shared paradigm and by widely accepted conventions, supported by entrenched institutions and by consensus over how and when disputes become settled; but arguments over anomalies are not so constrained: they are messy and may continue long after they — on purely epistemic grounds — should (Bauer, 1988).

Anomalies which invite consideration of human consciousness and examine its demonstrated effects, are even more problematic:

Anomalies research also risks encumbrance by scientific stodginess, scientific segregation, and scientific secularity. In particular, the contemporary rejection by established science of its own metaphysical heritage and essence precludes its further evolution into physical and biological domains where consciousness plays demonstrably active roles (Jahn, 1989).

A culture of critical thinking may be very resistant to the elevation of curiosity. Academic culture continues to maintain a ‘network of commitments’ across many dimensions: social, political and epistemic. Furthermore, institutions of scientific research have adopted a defensive posture. As Sarder (2000) indicates, the public is ready to challenge scientists because of their close association with issues such as environmental destruction, industrial capitalism, military weapons research and more recently, the genetic modification of food. In view of these challenges, academics are not likely to elevate a culture of curiosity above critical thinking. They are more likely to invest in processes which confer status and power: the strategies of deliberation, judging intellectual products and establishing standards of adequacy (see Figure 3). As long as anomalies continue to create tension and provoke crises, academic culture will tend to devalue curiosity. The commitment to critical thinking favours puzzle-solving and the limited nature of acceptable solutions. A culture that elevates curiosity above critical thinking may only be possible in newly, emerging organizations.
Anomalies are of particular interest to the curious learner. This type of learner is continually scanning the environment, actively searching for them. Upon their discovery, a state of anxiety occurs which must then be resolved. Orbach’s (1979) theoretical model of motivation could profit from further consideration. How does the presence of anomalies change motivation for other types of learners? Is the conscientious learner simply uninterested in anomalies, preferring instead to seek approval from an authority figure? Does the sociable learner worry about being ostracized if they fail to conform to conventional perspectives? Does the complexity of an anomaly frustrate the achieving learner because too many blind alleys must be investigated, and there is no clear victory condition which will position the learner within an identifiable hierarchy? How does the ‘violation of expectation’ relate to other features which appeal to the curious learner—novelty, surprise and complexity? What are the implications for the design of instruction? If anomalies are generally disparaged within the research community then how well does conventional instruction integrate an appreciation for anomalies into the curriculum? While academic culture may employ ‘social’ strategies to maintain their network of commitments, there is a ‘societal’ need to challenge them.

In his short treatise, Sarder (2000) summarized the developments in the sociology of science since the publication of Kuhn’s work. He refers to the ‘schizoid self-consciousness’ of science, where the gap between scientific expertise and public concerns must be bridged:

In post-normal science, the qualitative assessment of scientific work cannot be left to scientists alone—for in the face of acute uncertainties and unfathomable risks, they are amateurs too. Hence there must be an extended peer community, and they will use extended facts, which include even anecdotal evidence and statistics gathered by a community. Thus the extension of the traditional elements of scientific practice, facts, and participants creates the element of a new sort of practice. This is the essential novelty in post-normal science. It inevitably leads to a democratization of science (2000, p. 64).
Simulation/games provide a rare forum for the public to use explicit and profound interdisciplinary metaphors. Practice in the use of these metaphors may include: thoughtful reflection, developing intellectual self-confidence, identification of concepts, evaluation of relationships, experimenting with strategies and arguing persuasively. These experiences would empower members of the public to engage in debate with scientific experts.

In the game *Syd Meier’s Alpha Centauri*, the end-user must acquire understanding related to social engineering, diplomatic relations, infrastructure development, military deployment... and then discover the relationships between each of these objects. It is unlikely that an academic researcher would ‘know’ these relationships. Any attempt to proclaim such knowledge would be considered unbridled hubris. Simulation/games provide a forum for investigating the dynamics of complex systems and emergent behaviour related to the ‘sociological and political’ dimensions of intellectual thinking. These provide and are appropriate for an innovative type of learning:

Innovative learning... is needed to prepare the younger generation for emerging social circumstances. The current educational systems should stimulate more the learner’s self-organizing capacities for learning, and for learning to learn. The heuristic learning environment is appropriate because it enables learners to improve their search strategies for finding acceptable solutions to complex problems on the basis of available knowledge. This type of learning not only stresses domain-specific knowledge transfer, it also *emphasizes the importance of cross-domain or strategic knowledge* [italics added]. Current problems cannot be solved by narrow technical means based on a purely rationalist conception of reality... they require new approaches to societal steering... Gaming is an appropriate apprenticeship environment for managing complexity, uncertainty and value adjustments (Klabbers, 1996, p. 90).

Future research would profit from a deeper exploration of theoretical relationships between strategies for attaining cross-domain knowledge and interdisciplinary metaphors.

Game designers may need to explore the appeal of an anomaly. For instance, if you are an environmentalist and a simulation/game requires an encounter with the consequences of economic or military policy, does the presentation of these perspectives
hold the same appeal as anomaly? Do they violate your expectations as an environmentalist? The initial presentation of cross-domain knowledge may be novel, complex and surprising but how can one design anomalies? Should the designer make an effort to integrate incongruities into the design of the game, or will the various perspectives merely be modeled and the incongruities allowed to emerge as part of the complexity of game-play?

Critical thinking overlaps curiosity along those dimensions associated with fair, open and independent-mindedness. These may correspond with the game designer’s desire for plausibility and need to intentionally distort their abstractions in order to focus the player’s attention. However a fourth dimension of critical thinking, an inquiring attitude, may be the most difficult to cultivate. An inquiring attitude is not the same as curiosity. An inquiring attitude is bounded by tacit understandings of what may constitute a legitimate question. These are guided by existing concepts, beliefs and values (see Figure 3). Curiosity is more open to values of non-conformity and tolerance of incongruity. One theory proposed four interlocking frames of knowledge that are partially dependent on each other: content, problem solving, epistemic and inquiry (Perkins and Simmons, 1988).

Conventional instruction focuses only on the content...Inquiry is the hardest to cultivate among students and professionals...The inquiry frame encompasses knowledge and attitudes having to do with (a) extending a theory or framework beyond its usual scope and (b) challenging elements of a theory or framework. Such patterns of thought are not so commonly found, even in experts in a field (p.313).

Simulation/games seem to hold an intrinsic appeal for the learner who is already disposed to curiosity. Can a capacity for curiosity be developed? Can a learner discover a joy for tolerating incongruities where no such capacity existed before? Can a learner be comforted by non-conformity where they previously experienced anxiety? Or are these
features fundamental pre-dispositions—part of one’s temperament? As a habit of mind, an inquiring attitude can presumably be developed. The answers to these questions are needed to explore larger sociological issues. If curiosity is nature-dependent and curious learners are in the minority, then simulation/games are not likely to rise above their marginalized status. If curiosity can be developed, in a sufficient number of learners, then simulation/games may have a vital role to play towards empowering the public to debate with scientific experts.

Perhaps the curiosity of learners is a largely unmet need that crosses all sectors of society—a need that existing institutions of higher education are not organized to meet. Perhaps, the current consumption of entertainment in multiple mediums (including film, television, video arcade games, music, books and theatre), represents this unmet need. If this is so, then the convergence of information technologies may inevitably include some iteration of simulation/gaming—an opportunity that online marketers of education will seek to profit from. There are many kinds of games being marketed for both personal computers and console units (which attach to television sets). A large sector of the market does not simulate strategies (i.e. ‘first person shooter’ games such as Quake). Those games which do simulate strategic decision making, usually include some element of military conquest. In Alpha Centauri, a successful but yet-to-be-imitated title, the end-user can ‘turn off’ the military aggressiveness of competitors and concentrate on the other functions (explore, build and discover). Those games which are exclusively simulations (i.e. no element of combat or military conquest) are a relatively small sector of the market. In this study, one respondent referred to the Sim-City franchise of Maxis Software as being the only market success that could be considered an open simulation.
While computer simulation games are not the largest part of the market, this genre is nevertheless being purchased by hundreds of thousands of consumers each year. *Sim City* has been purchased by 10 million consumers (Gussin, 1995). Future researchers may wish to explore a deeper analysis of the market implications.

To meet the civic goals of education it is a second possibility, the societal need to empower a learning public that is of most interest. An ‘invitation to a party’ is an appropriate metaphor when considering simulation/games. Party goers may choose to approach anyone at the party and once the conversation begins, navigate through a social context searching for shared understanding. Each party goer is welcome to initiate interactions based on their own personal agendas—pursuing those of interest while ignoring others. The metaphor proposes that simulation/games are an everyday ‘house’ party where the only price of admission is a simple invitation. It further proposes that higher education may be considered a ‘members-only’ knowledge club where members include only those who have ‘paid their dues’ and endured the appropriate initiation. Those who are excluded have yet to be initiated into the many tacit understandings of membership. Furthermore, should a non-member become a ‘guest’ at a members-only club, the social milieu may be intimidating and the guest is challenged to negotiate the structures of conformity which support the cohesiveness of the ‘club’. A simulation/game such as *Alpha Centauri* invites learners to explore the possibility of membership if such disciplines as economics, diplomacy, engineering, sociology and military strategy. To extend the metaphor even further, if the public is to be empowered to engage in debate then everyone must be invited to the ‘knowledge’ party.
An Invitation to the Knowledge Party

Simulation/games are relevant to learners because they provide an important opportunity for developing strategies to manage complexity. Citizens need to be ‘invited’ to participate in constructing an awareness that encompasses multiple knowledge domains. The sheer volume of information is overwhelming. Tools and strategies are needed for managing this glut. The knowledge disciplines of formal learning function as exclusive knowledge ‘clubs’ for ‘members-only’. Whenever an individual begins exploring an unfamiliar domain of knowledge, he/she is like a working-class citizen entering a society charity event—many of the tacit understandings of the social context are not immediately apparent, and the individual is susceptible to inadvertent clumsiness and socially awkward faux pas. Furthermore, if the members-only knowledge club does not have the commitment or skills of social grace to facilitate inclusiveness, the knowledge explorer may be actively discouraged from further exploration. In the modern world, we are all knowledge-explorers subject to social exclusion. As individuals, each of us cannot reasonably be expected to join several ‘clubs’ before being considered worthy to engage in the social construction of knowledge. Formal learning allows us to be included in ‘members-only clubs’, but as citizens who value the democratic process, we should also recognize the benefits of throwing a ‘knowledge party’ and ‘inviting everyone’, where the only criterion for admission is the willingness to satisfy your curiosity. This purpose has also been well served by nonformal and informal learning opportunities (i.e. social activism, volunteer organizations, on-the-job training), and formal learning has always sought to advance the democratic enterprise. But the complexity of the modern world combined with the urgent
need to solve global inequities, as well as the crisis in environmental and public health, suggests that citizens need to be empowered with a deeper understanding across more knowledge domains. The Internet provides a significant opportunity for informal learning. However, the online education as it is currently constituted, seeks to duplicate the content-retention learning of distance education or the ‘chat-room’ equivalent of a graduate level seminar. Computer simulation/games provide an opportunity for deeper engagement across multiple knowledge domains. Thus they provide the opportunity to advance the democratic aims of formal learning in the online environment.

Simulation/games are a surprisingly stress-free introduction to useful concepts. They also provide practice in constructing strategies. Furthermore, each learner needs to become familiar with the extent to which knowledge is socially constructed, especially within academia. They need to develop the intellectual confidence to challenge and engage in dialog with experts. They need to feel ‘invited’ to the ‘knowledge party’ rather than being left out in the cold. The simulation/game is our invitation. Ultimately, as democratically-minded citizens, we need to question whether we want to join a particular ‘knowledge’ party or what ‘parties’ we are being excluded from. Such questioning may form the subtext of stealth learning or learning-by-accident as described by designers interviewed for this study—without conscious awareness we may gain intellectual confidence that prepares us to dialog with the domain experts of the members-only knowledge clubs. I will never be a diplomat but can practice diplomacy in a game, and then question the foreign policy initiatives of various countries. I will never get to decide military budget issues but by questioning military procurement in a game, and I can then begin to understand how to do this in my life outside the game.
To further the analogy, game designers may be intent on ‘crashing’ the party. They are not waiting for formal validation from academia. They are aware of the drama of human existence and are representing it, using both formal learning and intuitive understanding. In recent years, ‘massively multi-player’ have emerged. Thousands of people login to a host site and play the game with each other, at the same time. This new technology is fostering the development of online gaming communities and holds the promise of more social interaction…and social construction of knowledge. But why are millions of consumers (mostly males in their 20s and 30s) so hungry for these products? Is there pent-up demand to express curiosity and to socially construct knowledge? A life of informal learning over the Internet may incubate new values in the learning public—a deeper appreciation for constructing one’s own understanding, an awareness of the need to refine arguments by actively engaging in conversation (rather than passively receiving data from others), and a more acute cynicism about the value of credentials. Later on, when these learners are ready to choose formal learning they may wish to customize these experiences to their own personal measures of utility, citizenship and critical thinking.

The combination of simulation/games and online education has the potential to provide customized learning, and with it the possibility of eroding the pre-eminence of conventional instruction. The seeds of these new institutions are already apparent. One e-commerce company reported that they are offering online simulation games for business executives (Armstrong, 2000). The following is a sample from their marketing website:

Why do you need Ninth House Network? Two words: New Economy. The old economy required four-year degrees. The new knowledge-based economy

Their promises to the learner include:

- An engaging, interactive experience
- Development delivered directly to employees' desktops [personal computer]
- Personalized, customized learning
- Entertaining and enlightening content
- Centralized communications and community

The interactive simulations are delivered over the Internet for management executives who need to prepare for a meeting and want to practice their skills. Also of interest are two listings of interactive online simulations. These are listed on the websites for National Science Foundation (United States) (2000) and Maricopa College in Arizona (2000). These are the first indicators that simulation games are migrating to the online environment. They have yet to transcend their marginalized status. Thus the knowledge parties are more analogous to an informal gathering of friends than a formal gathering intended to serve a larger expression of communal values. And the social function of simulation games, as invitations to the knowledge party, remain correspondingly modest.

**Advent of New Technology in Education**

In 1855, the latest development in educational technology was described (Johnson, 2000):

> [This device] appealed at once to the eye and to the ear, thus naturally forming the habit of attention, which is so difficult to form by the study of books....Whenever a pupil does not fully understand, [it] will have the opportunity ... of enlarging and making intelligible (p.1).

This quote describes the 'high technology' development of the chalkboard:
This now standard piece of educational equipment was not accepted or used by teachers when it was first introduced. It wasn't a matter of teachers being stubborn or fearful of the "new technology." It wasn't because teachers didn't know how to use the device. The chalkboard just didn't fit in with the way schools of the 19th century were structured. The vast majority of schools at that time were one room buildings which held students of a wide variety of ages - anywhere from 5 to 17. This meant that the teacher spent almost no time teaching to the entire class; she taught to small groups of children, each with his or her individual slate. It wasn't until schools were "restructured" in the 20th century and students were separated into "classrooms" by age, that large group instruction and the use of the chalkboard became widely practiced. By the way, college professors of education, "the experts", extolled the virtues of the chalkboard for years before it was widely used by practicing teachers. This had less to do with their visionary abilities, and more to do with the fact that they were already using large group instruction methods (Johnson, 2000, p.1).

This analysis implies that the utility of education technology only receives recognition as a changing social context begins to emerge. Another education technology was the advent of the written word. There was a point in pedagogic history when students had access to books for reading but not to paper for writing (Graff, 1979). Thus they learned to read but not to write and this type of education functioned as a form of social control. Any attempt to foster computer literacy cannot be viewed as ideologically neutral (Postman, 1992; Street, 1997). If the convergence of simulation/games and online technology attains a critical momentum, and if the invitation to the knowledge party is extended to large numbers of people, then we can expect a challenge to the prevailing ideology. This might arise from support for curiosity that will engage the learner's sustained will to create knowledge. In most regions, there has been a strict division between knowledge producers and knowledge consumers. However, in Silicon Valley and other high technology regions, a rich interplay between knowledge producers and consumers can be observed (Brown, 2000). This interplay is one of the primary metaphors of online education:
A key understanding is that on the Web each of us is part consumer and part producer...the great opportunity here is that the Web helps establish a culture that honors the fluid boundaries between the production and consumption of knowledge. It recognizes that knowledge can be produced wherever serious problems are attacked and can be followed to their root...it increases the intellectual density of cross-linkages. It allows anyone to lurk and learn (Brown, 2000 p.20).

The larger implication for higher education is that learners need to become not just consumers of simulation/games but producers of simulation/games. Just as students who are taught to read but never to write, receive an education that is qualitatively deficient—the same can be said of any education technology where knowledge is consumed but not produced. Thus understanding how game designers produce simulation/games becomes relevant to future speculations about the advent of education technology.
CHAPTER 6

FUTURE RESEARCH

Anecdotal Reports of Interest

During the interviews many issues were introduced by the respondents which were not the focus of the study but provided anecdotal reports that may be of interest to future researchers. First, one designer is often approached by educators who believe his game can undergo minor modifications to create an 'engine' for other kinds of simulations. Second, one company collaborated with teachers in the K-12 system. This could serve as a model for other efforts. Third, the U.S. military actively scrutinizes development in the game industry, particularly with respect to simulations of human behaviour. Fourth, gender differences between boys and girls are evident when comparing the desire to build or fight. Fifth, simulation construction kits are available to middle school children (ages 9 to 11). Will the younger generation develop more ease with technology than the older generation of instructors?

Simulation Engine: Build or Buy

One celebrated designer of simulation games is often approached by educators who assume his software program can be easily adapted to accommodate K-12 instruction. He has often advised these educators that software (i.e. simulation engines) cannot be adapted and he must begin from scratch each time he develops a new product. The re-usability of programming code is a much sought after goal in the field of software engineering. The conventional wisdom is that while re-useable code may be possible in
other software products (i.e. operating systems, databases) it is problematic with regard to entertainment software.

I have a lot of teachers that call me up...and are either developing simulation games or want to get us involved. What strikes me on average is how little they understand of the economics of the entertainment industry....There's always this common fallacy that ...all they have to do is use our simulation engine and change the content and all of sudden they have a highly polished commercial level educational simulation....Somehow we've done all the magic work in this black box and all they have to do is plug in different numbers and different graphics and all of a sudden it works. If it were only so simple. In my experience, most of these things are a far more integrated development task ...we re-enter the interface every time, we render the simulation every time. And it's more about the experience that you gain in these things, so the next time you know how to do it quicker and faster. But in the entertainment industry you're always chasing this kind of abstract concept of state of the art, which goes a long way toward pumping up our development budgets, and forcing us to spend [money]. It becomes an arms race in the entertainment industry, which isn't necessarily the case in the classroom except in so far as they're trying to transfer the idea that kids are incredibly captivated by this stuff, and that they're actively pulling on this stuff in terms of...spending hours and hours of their free time in front of some of these games. You can't pull away from these games. They're looking at that as a powerful upside. If we could only harness that motivation of these kids towards educational areas you know why this media is so so entirely captivating to this generation 'How can we harness that power?' Which is a very well founded observation. But on the other hand a lot of that is because the kids perceive it as entertainment and to be in the entertainment area you have to enter this arms race. There other good educational games out there that in terms of technology and presentation, five to six years old that kids will play with and they might enjoy it a bit more than a book but they're not going totally go bonkers over it the way the would the latest video game. Respondent #17

Future researchers might consider doing a case study of a development project and identify why simulation software must be custom-designed each time and cannot be re-used.

A Successful Model: Droidworks From Lucas Learning

*Droidworks* is a product developed by filmmaker George Lucas. It featured android characters based on his Star Wars license. Furthermore, it was a sincere effort to develop an educational product for K-12 students. The point of the product was to build androids and send them on specific missions. The android parts consisted of limbs and torsos of varying dimensions and functions. The student would send the android on a mission to cross quicksand. For instance, if the android was too heavy and didn't have appropriate features, it would sink and the student would have to solve this problem.
Respondent #16 reported that teachers were recruited at the beginning and consulted throughout the development process. It was not a collaboration where all members of the team had equal authority. Teachers were contracted as consultants and the final authority to make decisions resided with the game designers. Teachers tended to be ‘early adopters’ of technology. Teachers were most helpful in deciding on the difficulty level of mission tasks. In general, the game designers made the tasks too difficult and these tasks were made easier on the advice of teachers. This type of development project might be appropriate for a case study.

Researcher: This study presumes that home entertainment game designers may try to work with faculty/instructors at some point in the future. And if they do, there’s going to be differences that exist. Do you have any idea how these differences might be remedied?

Respondent #16: I’ve worked with faculty and instructors and it’s never really been a big problem. I think the differences are worked through by simply listening to what faculty/instructors have, trying to incorporate as much as you can of what they suggest, but explaining that there is going to be compromises within the environment of making a game. And that seems to never have been too much of a problem. Partly it’s because we choose faculty/instructors that like games, or what we look for in faculty/instructors are ones that enjoy learning in a variety of different ways, that are very open to different kinds of ways of teaching kids. They see validity in teaching through games, through computer games. So we don’t really look to work with faculty/instructors that are... closed off to that point of view. So we’ve never really had a problem.

Researcher: Did you bring them in as consultants on your project that you were funding? And were you having to comply with curriculum guidelines or anything like that?

Respondent #16: Well we did bring them in, and, no, we did not have to comply with curriculum guidelines. Again they were not big believers in having to follow curriculum to the tee. And we made that really clear up front that we were not going to make a game in a pedagogical way; that we were going to do it from a more free form aspect.

Researcher: And were they intending to use your game in the classroom?

Respondent #16: We made it really clear up front that we were not trying to make a game for the classroom, but that we hoped it would be picked up by teachers; that they would see it as a tool for the classroom; but that we were trying to make a consumer product first. And so therefore...following the curriculum was not as important. The fun factor had to be there. They were fine with that. And in the end, they thought that they would like to use it in the classroom. We both felt like we had achieved our goal.

Researcher: If these two groups try to work together in the future, would a possible remedy be for them to buy-in to the same vision from the beginning or should they just jump in and
try to work things out. From your previous answer you seem to value pre-planning and right from the beginning.

Respondent #16: We believe it has to be right from the beginning. When we first start a product, we get a sort of a cross-section of experts to come in and brainstorm a concept at the very, very beginning, when it is just kind of a germ of an idea almost. And we bring them in and they don’t necessarily have to be teachers. They can be just experts in the field of study or the field of content that we’re trying to explore within the game. From there we choose the content specialists that we feel we worked best with, or we shared the same vision as we do for the game. And then we ask them to come back and work with us throughout the development of the game. I feel that has worked really beautifully and I feel like that’s the only way to do it. You try to bring someone in the middle of the game and they’re going to start wanting to change it and they’re not going to understand the vision at all of the game. So you [the lead game designer] [are] just going to have to continually going back to them [new team member] and explaining to them, ‘Well this is why we did this. This is why we did that.’ As opposed to bringing them in the beginning and they understand that you don’t have to keep backtracking.

Researcher: And so you’re brainstorming initially and then how did the vision become finalized? Was it more like you were using their input into the vision and then it was your vision and you were the champion of the vision?

Respondent #16 Yeah. As the game design gets put together you give them all the documents. You’re constantly feeding them the documents to review. What we did is bring them in every month and a half or every two months. And we would keep them up to date with the documentation that was being produced for the game, so that when they did come in they were up to date on it all. And then, we would definitely incorporate their input into the game. There were some things that we were really clear about up front. [Some things] that just wouldn’t work and other things we were extremely thankful and grateful for. [They] straightened us out and pointed us in the right direction. Because content-wise, especially on the content levels, they taught us a few things.

Researcher: So were there any people that left because they didn’t agree with the vision? Did all these faculty/instructors pretty much stay through until the end of the project?

Respondent #16: They stayed through to the very end.

Future researchers could interview all members of the development team and explore those issues that support the teaching utility of the software product.

Military Learns From Entertainment Industry

Even though the purchase price of simulation/games is low, they are sophisticated. It is a fact that the U.S. military are world experts in physical simulations (i.e. cockpit, helicopter, tank simulators, etc.) but they look to the home entertainment industry for
expertise in simulations of human behaviour. Respondent #19 indicated that the United States Air Force co-sponsors an annual conference with home entertainment game designers to encourage a cross-fertilization of technology between the two industry sectors. It is also interesting to note that scientists in artificial intelligence are also reporting the sophisticated nature of computer game technology. At the same industry trade show, a discussion facilitator made the following report:

Two guests in one of my roundtables, one a physics major dabbling in AI, and the other a formal AI professor, were adamant that the game industry appears to be light years ahead of academia in producing practical, working AI solutions to some very tough problems (Woodcock, 1999, p.4).

This would indicate that expertise being developed by the entertainment game industry is of a non-trivial nature and may very well be at the leading edge of technology development.

The military is primarily interested in entertainment simulations because of their capacity to model human behaviour. This is currently a weak part of their simulation technology. Future research could identify what lessons in human behaviour the military are learning from entertainment simulation games.

Researcher: This study presumes that game designers of home entertainment products will have different views than professor instructors. If these differences do exist, how do you think they might be remedied?

Respondent #19: One way to remedy is a solution which I’ve been seeing between the military idea of simulations and the computer game industry. There is a convention once a year, that the Air Force puts on that brings both computer game designers and military designers together to communicate...That has proved to be of large value. I would think a similar approach between the education space and the game space would produce also interesting synergism.

Researcher: So what kinds of issues have they tried to resolve.

Respondent #19: It’s not so much resolving issues as communication between the two and allowing for synergy to learn things and so on, see how others are approaching it.

Researcher: I would imagine that the military would want a high correspondence between reality with their simulation whereas game designers seem to want the freedom to, as one person puts it ‘fudge the margins’, in order to make the game more fun. Are people
in your instance of this Air Force conference developing tolerances for each other's perspectives?

Respondent #19: Yes. And grabbing with each other’s perspectives, although the two goals may be different. How they go about the goals overlaps a great deal. This in turn basically brings out that synergism. In other words an entertainment simulation may have a high amount of detail. Sometimes they have more detail than the military sims. And therefore the goal, although different, may bring out results which are useable from the other side.

Researcher: Would a possible remedy involve both parties buying-in to the same vision right from the beginning or should they just jump in and try to work things out?

Respondent #19: You can’t buy-in to the same vision simply because goals drive everything. The goal of entertainment, the goal of education, the goal of simulation, are distinctly different. It's just that as one group goes toward one of the goals, it may solve problems that the other can use.

The military has enjoyed a long association with the benefits of learning through simulation but only one report could be identified in the academic literature (Hodgetts, 1970). Perhaps a specific military literature exists but is considered classified and therefore it has not been disseminated. Future researchers might attempt to access this literature if it exists.

**Girls Like to Build, Boys Like to Fight**

I attended one round-table discussion entitled ‘Designing non-combat strategy games’. Within minutes the attendees reached agreement that we were talking about simulation games. I was the only woman in a room of about 50 men. As the discussion proceeded, the men reported four instances of females, (either wives or 8-year-old daughters) who enjoyed playing the build functions of typical wargame products, but as soon as the combat started, they stopped playing.

One of the most successful franchises (sometimes referred to as strategy games) would be those products developed by Syd Meier. His most recent computer game has concisely described four primary activities: build, conquest, explore and discover.
Increasing difficulty level seems to be achieved primarily by increasing the opportunity for war. If this is true, then it may represent a definite bias towards a male aesthetic. Females might prefer to experience higher difficulty levels that emphasize the build, explore or discover activities. Future researchers could explore the design choices of existing products and categorize the ways difficulty levels are constructed.

**Generation Lap: Simulation construction kits in U.S. middle schools**

The phenomenon called *Generation Lap* may be another societal trend (Rooney, 1999). The term is reminiscent of the 1960's term *Generation Gap*, where the demographic bulge of the baby-boom generation came to dominate social, economic and political concerns during that decade and beyond. In the current context, *Generation Lap* refers to a younger generation who are more familiar with technology than the older generation. Like an adept runner racing around a track, this proficient younger generation (of students) is more capable of 'lapping' the older generation (of faculty/instructors). A technology-savvy younger generation may create a market demand for technology-based instruction. If this younger generation is already a mass consumer of sim/game home entertainment products, then educational producers may be able to leverage opportunities if their educational products exploit similarities to sim/games.

Evidence of a generation lap can already be seen in some elementary schools. While most computer games are intended as consumer products, there is another class of products intended for middle-school students (i.e. children aged 9-11 years). These
products are called simulation construction-kits (Schmucker, 1999). They are toolkits that enable children to construct their own simulations, just as word processing applications are toolkits for writing essays. One product, *Cocoa Internet Authoring for Kids* (Kids Domain, 2000) has been developed by a major computer manufacturer and is available to teachers free of charge. Schmucker (2000) reported that 50,000 copies have been downloaded from the Internet and that this product is being used by elementary school teachers who are so-called early-adopters of computer technology. In these classrooms, children have the opportunity to develop simulations as an alternative to writing essays. These simulation construction kits may become yet another marginalized instructional method. Like other instructional simulation activities, their use currently depends on the personal commitment of individual teachers. There is no indication of widespread implementation in the curriculum. Future research could investigate the implementation of this simulation construction kit activity and track its progress.
CHAPTER 7

CONCLUSION

The sources of disjunction/overlap between professor/instructors and simulation/game designers arise due to two distinct cultures, critical analysis versus curiosity. If the culture elevating curiosity is not unduly constrained by critique, then simulation games may serve as an access point to learning, especially for initial access to inter-disciplinary perspectives. Simulation/games serve to ‘invite everyone to the knowledge party’ rather than excluding learners from the ‘members-only’ club of accepted disciplines.

In any collaborative effort, commercial game designers are likely to view themselves as the experts with regard to the commercial imperative for profit. The development of commercial products also requires a tolerance for the iterative nature of design. The context of commercial game development suggests that professor/instructors will be expected to accommodate the market demand to design for specific closure, as well as demonstrate a tolerance for the iterative development process.

The early conceptions of simulation/game design are still relevant. Game designers have indicated a significant commitment to representing objective knowledge. This commitment may provide common ground between the two groups. The need for plausibility in a simulation may facilitate future collaboration in the design of simulation/game software.

This study was not able to specifically compare disjunctions between home entertainment game designers and faculty/instructor designers because the latter subject
group could not be identified among the higher education faculty located in British Columbia. This result suggests that computer simulation/games continue to retain a marginalized instructional status within existing institutions. If instructional methods and simulation/game technology are to converge in the future, we can only speculate that it will happen as part of an emergent social context that values fluid boundaries between the production and consumption of knowledge, and an increased valuing of those habits of mind associated with an inquiring attitude.

The mass marketing of computer games is serving as a crucible to test the design of user-interfaces. Millions of consumers are being acclimatized to the complexity of these environments and the significant learning curves that are experienced just to play the game. With the advent of the Internet and online education a number of phenomena are converging. Currently, thousands of people routinely enter ‘massively multiplayer environments’ at the same time to play a medieval simulation called Ultima Online. This recent phenomenon suggests a surprising new potential for established notions of informal learning and the social construction of knowledge.

Better informed questions for future research would include three main areas: a) market profiles of the curious learner, b) theoretical conceptualizations about the appeal of anomalies, and c) design processes that include an integration of cross-domain knowledge strategies.

The market profile of the curious leaner would include the following questions: Does the curious learner actually exist as a marketing demographic? If so, are there enough of them, sufficiently committed to pursuing online education to warrant the investment in online simulation-games? Is curiosity nature- or nurture-dependent? Can
marketing programs create a demand for curiosity-based learning? Does the curious learner reject conventional instruction and seek other options? Are simulation/games a preferred option?

We need to understand the intrinsic appeal of anomalies—those incongruities that challenge conformity and must be integrated to abate an individual's anxiety level. With a more complete conceptualization, we might better understand how knowledge from one domain presents as an anomaly when viewed from another domain. If this can be understood, then we will have a clear understanding of how designers can become more conscious of processes that integrate cross-domain strategies. If these processes can be made more explicit, then game designers may be able to work more constructively with academics when creating learning environments for higher education.
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Appendix A – Pilot Study Consent Form
1. Definitions of a simulation/game:

In the design and development of simulation/games, two definitions seem to apply. Please review the definitions and indicate the extent to which you agree with the definitions.

Definition #1:
“A simulation game is a contrived activity which corresponds to some aspect of reality. The activity involves players who strive to resolve one or more conflict(s) within the constraints of the rules of the game. It comes to a definite closure with a determination of winners and losers.”

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<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
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Definition #2:
“A simulation is a working representation of reality. It may be an abstracted, simplified or accelerated model of the process. It allows the exploration of systems where reality is too expensive, complex, dangerous, fast or slow.”

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<th>Strongly Disagree</th>
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Would you modify any part of these definitions?

☐ No

☐ Yes  If yes, then please elaborate

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________________________________________________________________________
Design and development of simulation/game software

2) End-user outcomes

To what extent do you agree, the end user should:

1. Handle interrelationships among a number of variables
2. Make effective decisions about allocating resources
3. Make effective decisions about negotiating with other players (either real or virtual)
4. Make effective decisions about sequences of actions
5. Be able to explore an issue from different perspectives
6. Be able to explore the objective knowledge of each perspective
7. Be able to explore the subjective worldview of each perspective
8. Be able to transfer newly learned skills to a real-life decision-making situation
9. Be able to transfer newly learned knowledge to a real-life decision-making situation
10. Be able to transfer their newly learned skills to real-life interactions with others
11. Be able to transfer their newly learned knowledge to real-life interactions with others
12. Be required to deal with various strong feelings and emotions associated with the simulation/game
13. Experience fun while engaged with the simulation/game
14. Find the simulation game to be a plausible representation of reality (few instances of missing information)
15. Be able to assume a specific role and compete with other players (either real or virtual)
Design and development of simulation/game software

16. Be able to operate from a specific perspective and compete with other perspectives (either real or virtual). Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

17. Not compete with others but rather act like the 'god' of the game, having the sole power to change variables. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

18. Experience the closure of the simulation/game, with a final determination of winners and losers. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

19. Experience the closure of the simulation/game after specific duration of engagement. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

20. Not experience a final determination of winners and losers. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

21. Be primarily motivated to gain strategic advantage for the purpose of winning the simulation/game. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

22. Be primarily motivated to modify variables and observe the consequences, for the purpose of reflecting on the significance of these consequences. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

23. Experience consequences as a result of their decisions. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

24. Feel personal risk while engaging the simulation/game (i.e. thrill of victory or the agony of defeat). Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

25. Maintain a degree of detachment while engaging the simulation/game. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

26. Understand that the simulation/game was a contrived experience that will have no detrimental impact on their real life. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

27. Find the simulation game personally relevant because actions are embedded in the context of real-life data. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

28. Find the simulation game personally relevant because the imaginative associations of the simulation/game correspond to the beliefs and values of the end-user. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree

29. Find the most important learning occurs during the debriefing session after closure of the simulation/game. Strongly Disagree Disagree Slightly Agree Agree Strongly Agree
Design and development of simulation/game software

30. Find the most important learning occurs during engagement with the simulation/game, as the end-user experiences consequences. □ □ □ □ □ □ □ □

Please include any comments about end-user outcomes.
### Design and development of simulation/game software

#### 3) Design Priorities

In the design of simulation/game software, to what extent are the following priorities?

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<th>Priority</th>
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<tbody>
<tr>
<td>1. Representing conflicts</td>
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<td>2. Representing a complex system</td>
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<td>3. Representing a subjective view of reality</td>
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<td>4. Representing an objective view of reality</td>
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<td>5. Representing a simplified version of a complex system which exists in real-life</td>
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<td>6. Representing a system which corresponds to real-life</td>
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<td>7. Representing a system which appeals to the imagination</td>
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<td>8. Providing a specific closure to the simulation/game so that the end-users will be motivated to 'win'</td>
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<td>9. Providing an open-ended simulation/game (with no determination of winners and losers)</td>
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<td>10. Providing many variables to be manipulated by the end-user</td>
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<td>11. Giving the end-user an opportunity to immerse themselves in the complexity of the system</td>
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<td>12. Design a user interface first then add real-life data</td>
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<tr>
<td>13. Start with the real-life data then design a user interface which represents the data</td>
<td>☐</td>
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</tbody>
</table>

Please include any other comments about the characteristics of design?
Design and development of simulation/game software

4) Contributing to the development of a simulation/game

I would contribute the following to the development of a simulation/game:

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identifying end-user roles</td>
<td></td>
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<tr>
<td>2. Identifying resources (within a simulation/game) to be allocated</td>
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<td>3. Identifying end-user constraints (i.e. how many actions per turn)</td>
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<tr>
<td>4. Identifying sequences of actions to be available to the end-user</td>
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<tr>
<td>5. Identifying consequences to be experienced by the end-user</td>
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<tr>
<td>6. Identifying relationships between specific data</td>
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<tr>
<td>7. Identifying a choice of multiple perspectives</td>
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<tr>
<td>8. Identifying fundamental principles for each perspective</td>
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<tr>
<td>9. Identifying assumptions for each perspective</td>
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<tr>
<td>10. Identifying the imaginative associations</td>
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<tr>
<td>11. Creating intentional distortions which abstract the real-life data</td>
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<td>12. Increasing the complexity of simulation/game</td>
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<tr>
<td>13. Decreasing the complexity of simulation/game</td>
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<tr>
<td>14. Creating the user-interface</td>
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<tr>
<td>15. Providing feedback to the design team about the user-interface</td>
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<tr>
<td>16. Creating visual feedback for end-user (i.e. trend graphs, maps, dialogue responses, transforming icons, reports)</td>
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<tr>
<td>17. Creating artificial intelligence (programming instructions) of the virtual competitors represented in the simulation/game</td>
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</tbody>
</table>
Design and development of simulation/game software

18. Creating artificial intelligence (programming instructions) of competing perspectives represented in the simulation/game

19. Identify the debriefing protocol to be used after engagement with the simulation/game

20. Identify criteria for winning and losing

21. Identify closure of open-ended exploration

22. Identify the duration of engagement with the simulation/game

Please include any other comments about contributions to the development process?
### 5) Expectations of the development process

To what extent do you agree with following statements about the development process.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I would expect most of my contribution to be made during the pre-planning stage</td>
<td></td>
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<td>2. I would expect some of my contribution to be made during the pre-planning stage</td>
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<tr>
<td>3. I would expect none of my contribution to be made during the pre-planning stage</td>
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<tr>
<td>4. During the development process, I would expect to improvise most of the time, with minimal look-ahead at each stage</td>
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<td>5. During the development process, I would expect to improvise some of the time</td>
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<tr>
<td>6. During the development process, I would expect to improvise none of the time</td>
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<tr>
<td>7. The development of a simulation/game involves infinite options and the design team must struggle to find even one design that works</td>
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<tr>
<td>8. The development of a simulation/game involves infinite options and the design team should expect to create successive iterations of the design until a final satisfactory design emerges</td>
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<td>9. The final design should be dominated by the specifications stated in the pre-planning stage</td>
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<td>10. The final design should be dominated by a personal aesthetic</td>
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<tr>
<td>11. In the development process, it is necessary to experiment with many options</td>
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<tr>
<td>12. In the development process, it is necessary to discard much</td>
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<tr>
<td>13. In the development process, it is sometimes necessary to do a complete rewrite</td>
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</table>
Design and development of simulation/game software

6) Demographic Information

To all respondents:

Thank you for completing this survey. I hope to complete my analysis of the survey data by May 31st.

Please indicate below if you would like to receive a copy of the results. I look forward to exploring these issues further and talking with you.

Thanks once again,

Deborah Warren
E-mail: dwarren@brock.housing.ubc.ca

Please correct any of the information in the space below:

Name: ____________________________________________

E-mail: ____________________________________________

I would like to receive a summary of the survey results soon after May 31, 1999:

☐ Yes
☐ No

If yes, please state mailing address ____________________________________________

__________________________________________

Briefly describe any responsibilities you have had associated with design and development of simulation games:

________________________________________________________________________

________________________________________________________________________

What is your country of residence? ________________________________

What is your age? ________________________________

Are you a man or a woman?  Man ☐  Woman ☐

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Design and development of simulation/game software

1. What roles best describe what you do? (Check more than one box if appropriate).
   - A game designer
   - A simulation/game designer
   - A professor
   - An instructor
   - A computer programmer
   - An expert with regard to a recognized discipline of knowledge
   - Other, please list ____________________________

2. Where do you spend most of your working day? (Check more than one box if appropriate).
   - Small company (1-10 employees)
   - Medium size company (11-49 employees)
   - A large company (more than 50 employees)
   - High school
   - College
   - Technical institute
   - University
   - Other, please list ____________________________

3. I am currently using a classroom simulation/game for instructional purposes.
   - Yes
   - No

4. I am currently using a computer simulation/game for instructional purposes.
   - Yes
   - No

5. I am intending to use simulation/games for on-line education (over the Internet) at some point in the future.
   - Yes
   - No

6. I am currently using simulation/games for on-line education (over the Internet).
   - Yes
   - No
Appendix C - Interview Questions
Design of Simulation/game software: Follow-up Interview

1. Do you have any comments about the survey?

2. When you answered these questions, were you referring to a particular type of simulation/game? (i.e. open or closed)?

3. Was this survey a fair representation of design issues or does it barely touch the surface?

4. Were there any questions that were confusing?

5. Check responses for the following themes. Are there any patterns?
   - Open exploration versus closure (with final determination of winners and losers)?
   - Subjectivity versus objectivity?
   - Development process: pre-planning versus iterative?

6. When end-users spend do much time playing computer simulation/games, if they are not learning then what else is going on? - Addictive behaviour? - Obsessive compulsive disorder?

7. When you think of teaching and learning what is the first idea that comes to mind?

8. Is having fun with a computer simulation/game incompatible with learning?

9. Should having fun be subordinate to learning or should having fun be dominant over learning?

10. This study presumes that game designers of home entertainment products will have different views than faculty instructors. If these differences exist, then how can they be remedied?

11. Would the remedy involve negotiating a compromise during the development process or must all parties agree on the same vision from the beginning of the development process?
Appendix E - Respondent Consent Form
Appendix F – Respondent profiles

**Respondent #1:** Male U.S. Age:37
Lead designer simulation/games
Lead architect:
large scale distributed simulation
Computer programmer / Large company

**Respondent #2:** Male U.S. Age:38
Designer of simulation/games
Small company /
Consultant to U.S. Military

**Respondent #3:** Male U.S. Age:28
Scenario editor development
Host development for large scale role
Playing game
Networking and architecture development
Game designer / computer programmer
Large company

**Respondent #4:** Male U.S. Age:28
Producer and game designer
Large company

**Respondent #5:** Male U.S. Age:30
Design for military flight sim
Briefing and Debriefing writing
A simulation/game designer
Large company

**Respondent #6:** Female U.S. Age:37
designer, writer, lead designer, producer,
head of product development,
a simulation/game designer
Small company

**Respondent #7:** Male U.S. Age:29
Designer, producer, programmer
Small company

**Respondent #8:** Male U.S. Age:26
Game designer
A designer of simulation/games
Large company

**Respondent #9:** Male U.S. Age:27
Lead designer and game designer
Small company
Ph.D. student in physics

**Respondent #10:** Male U.S. Age:29
Game designer / medium company
Provided random terrain generator,
historical data & context, story for single player
Formerly a professor of biology
Respondent #11: Male U.S. Age:35 Game designer / computer programmer, Expert on a specific discipline of knowledge Small company

Respondent #12: Male U.S. Age:28 Game designer / large company

Respondent #13: Male U.S. Age:22 Game designer / large company Producer, sound designer, mission builder and visual artist

Respondent #14: Male U.S. Age:39 Game designer, simulation/game designer Medium company, design missions and story for a well known license, scripting of cinematics, user interface design, play testing, manual and packaging design.

Respondent #15: Male U.S. Age:43 Manager / large company Programmer, lead programmer, designer, lead designer, producer, executive producer, vice-president of development

Respondent #16: Female U.S. Age:35 Game designer / medium company Project leader/designer of a well known license.

Respondent #17: Male U.S. Age:39 Game designer, simulation/game designer Computer programmer / large company Primary designer of six simulation titles

Respondent #18: Male U.S. Age:35 Game designer, simulation/game designer Large company

Respondent #19: Male U.S. Age:47 Game designer and developer since 1985 Simulation engineer since 1976 Small company

Respondent #20: Male U.S. Age:46 Game designer, large company Executive in design company (i.e. C.E.O), Programmer/designer, producer, executive producer Previously worked as elementary school teacher

Respondent #21: Male U.K. Age:29 Game designer, creative director, oversee art, a simulation/game designer,
Respondent #22: Female U.S. Age:30 Producer, medium company

Faculty/instructors

Respondent #51: Male Cdn. Age:52 College instructor, Uses computer simulation games No design experience with

Respondent #52: Male Cdn. Age:38 College instructor, Uses classroom/computer simulation games No design experience with

Respondent #53: Male Cdn. Age:56 College instructor, Uses computer simulation games No design experience with

Respondent #54: Male Cdn. Age:52 College instructor, university professor Has used computer simulation games Has designed classroom simulation/games

Respondent #55: Male Cdn. Age:38 University professor Has used computer simulation games No design experience with

* When a film, television drama or book is commercially successful, the 'licensing' rights are sold or issued to a game developer. A computer game is then designed using the characters, plot, etc, from the licensed story.
Appendix G: Anticipated Disjunctions

The following table was used to summarize anticipated disjunctions between home entertainment game designers (HEGDs) and professor/instructors (P/Is). These indicators were listed in the survey questionnaire that was administered to respondents before the interview.
Table 1: Summary of anticipated indicators described in questionnaire

<table>
<thead>
<tr>
<th>Anticipated response:</th>
<th>Neutral</th>
<th>Favoured by HEGDs</th>
<th>Favoured by P/Is</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Definition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- specific closure with winners and losers</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>- changing variables of an open system</td>
<td></td>
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</tr>
<tr>
<td>2) Learner outcomes...how important?</td>
<td></td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>- handle interrelationships between variables</td>
<td></td>
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<tr>
<td>- decisions about allocating resources</td>
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<tr>
<td>- decisions about negotiating</td>
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<tr>
<td>- decisions about sequences of actions</td>
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<tr>
<td>- multiple perspectives</td>
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<tr>
<td>- deal with various strong feelings and emotions</td>
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<tr>
<td>- assume a specific role and compete</td>
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<tr>
<td>- closure will occur after specific duration</td>
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<tr>
<td>- experience consequences as a result of decisions</td>
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<tr>
<td>- understand that it was a contrived experience</td>
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<tr>
<td>- choose a perspective/compete with other perspectives</td>
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<tr>
<td>- learning occurs as user experiences the consequences</td>
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<tr>
<td>- explore the fundamental principles</td>
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<td></td>
<td>Yes</td>
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<tr>
<td>- to transfer their skills to real-life decision-making</td>
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<td></td>
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<tr>
<td>- transfer their skills to their real-life interactions</td>
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<tr>
<td>- a plausible representation of reality</td>
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<tr>
<td>- not compete but has sole power to change variables</td>
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<tr>
<td>- no final determination of winners and losers</td>
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<tr>
<td>- modify variables and observe the consequences</td>
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<tr>
<td>- maintain a degree of detachment</td>
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<tr>
<td>- personally relevant real-life data</td>
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<tr>
<td>- learning occurs during the debriefing session</td>
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<tr>
<td>- to reflect on a subjective worldview</td>
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<td>Yes</td>
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<tr>
<td>- fun for the end-user</td>
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<tr>
<td>- a final determination of winners and losers</td>
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<tr>
<td>- gain strategic advantage to win</td>
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<tr>
<td>- end-user will feel personal risk</td>
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<tr>
<td>- imaginative associations correspond to beliefs/values</td>
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</tbody>
</table>
### 3) Priority characteristics of the design

<table>
<thead>
<tr>
<th>Anticipated response:</th>
<th>Neutral</th>
<th>Favoured by HEGDs</th>
<th>Favoured by P/Is</th>
</tr>
</thead>
<tbody>
<tr>
<td>- representing conflicts</td>
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<td>Yes</td>
<td></td>
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<tr>
<td>- representing systems</td>
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<tr>
<td>- simplified version of a complex system</td>
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<tr>
<td>- many variables to be manipulated</td>
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<tr>
<td>- opportunity to become immersed in complexity</td>
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<tr>
<td>- representing an objective view of reality</td>
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<td>Lower priority</td>
<td>Highest Priority</td>
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<tr>
<td>- a complex system which corresponds to real-life</td>
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<tr>
<td>- open-ended...no determination of winners/losers</td>
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<tr>
<td>- start with real-life data then add user interface</td>
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<tr>
<td>- representing a subjective view of reality</td>
<td></td>
<td>Highest priority</td>
<td>Lower priority</td>
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<tr>
<td>- complex system which appeals to the imagination</td>
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<tr>
<td>- a specific closure that motivates to win</td>
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<tr>
<td>- design user interface first then add real-life data</td>
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### 4) Contributions to the development process: none, some, highest?

<table>
<thead>
<tr>
<th>Anticipated response:</th>
<th>Neutral</th>
<th>Favoured by HEGDs</th>
<th>Favoured by P/Is</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Identifying end-user roles</td>
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<td>Some or highest</td>
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<tr>
<td>- Identifying resources to be allocated</td>
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<tr>
<td>- Identifying end-user constraints(actions per turn)</td>
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<tr>
<td>- Identifying sequences of actions</td>
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<tr>
<td>- Identifying consequences</td>
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<tr>
<td>- Identifying relationships between specific data</td>
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<tr>
<td>- Identifying a choice of multiple perspectives</td>
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<tr>
<td>- Identifying assumptions</td>
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<tr>
<td>- Providing feedback about the user-interface</td>
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<tr>
<td>- Identify the duration of engagement</td>
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<tr>
<td>- Identifying fundamental principles from real-life</td>
<td></td>
<td>No contribution</td>
<td>Highest contribution</td>
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<tr>
<td>- Increasing the complexity</td>
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<tr>
<td>- Identify the debriefing protocol</td>
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<tr>
<td>- Identify closure of open-ended exploration</td>
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<tr>
<td>- Creating intentional distortions</td>
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<td>Highest contribution</td>
<td>No contribution</td>
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<tr>
<td>- Identifying the imaginative associations</td>
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<tr>
<td>- Decreasing the complexity</td>
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<tr>
<td>- Creating the user-interface</td>
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<tr>
<td>- Creating visual feedback for end-user</td>
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<tr>
<td>- Creating artificial intelligence</td>
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<tr>
<td>- Identify criteria for winning and losing</td>
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<tr>
<td>Anticipated response:</td>
<td>Neutral</td>
<td>Favoured by HEGDs</td>
<td>Favoured by P/Is</td>
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<tr>
<td><strong>5) Expectations of the development process</strong></td>
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<tr>
<td>- <em>some</em> of contribution made during pre-planning stage</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>- <em>none</em> of contribution made during pre-planning stage</td>
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<tr>
<td>- I would expect to improvise <em>some</em> of the time</td>
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<td>- I would expect to improvise <em>none</em> of the time</td>
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<td>- find even <em>one</em> design that works</td>
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<td>- <em>most</em> of contribution made during the pre-planning stage</td>
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<td>Strongly disagree</td>
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<td>Strongly agree</td>
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<td>- successive iterations until a final satisfactory design emerges</td>
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Appendix H – Additional Excerpts from the Interview Data

**End-user outcome: Open Exploration:**

Exploring the simulated environment and ‘seeing the consequences’ was described as an activity that would appeal to ‘kids’.

I design for kids. I think its better when you give them an environment that they can explore and make their own, I... come to their own conclusions, as opposed to pointing them in a specific direction. Although within that I think that there should be some framework of story or framework of context In which they’re sort of looking around this environment but that you should leave as open as possible as to where they can go and explore. And the consequences of the things that they do, as opposed to leading them through it step be step. Respondent #16

**Knowledge Representation: Both Subjective and Objective**

Most of the descriptive answers were attempts to describe the designer’s commitment to objective knowledge and concurrent willingness to defer to a “need to make it fun”.

My take ... on the questions was, “Does the game designer have an axe to grind or are they trying to present a system, and trusting that the player plays a real system that the right lessons will be learned?” And there I’m all for objectivity because...in the end it becomes a journalistic endeavour. Now sometimes what happens is that the fun game-play and historical accuracy conflict. A great example is in baseball. If we made a pitch in baseball [and it] come[s] at you at the physically accurate speed. No one would ever have fun because you wouldn’t be able to swing and hit the ball....So we slow down the ball from true physics to make the game fun. Those are the compromises we have to make. But they’re not made with an editorial bias, they are made so that subjectively it feels like a fun game instead of it being an absolutely faithful recreation of the physics of what the real ballplayers do... You need poetic license...for it to be fun. Now for some games you never have to use it. But you need the poetic license in an awful lot of things. Respondent #21

It’s the playability versus realism question in a lot of the games I play and a lot of publishers have semi-resolved it by coming out and saying that, “In this game when we had a problem with a particular aspect of the design, we favoured playability over realism.” So they come out and tell you, “This isn’t intended to be a definitive realistic simulation. Its intended to be a fun game but it’s on this topic and some of it would hold up to scrutiny and be valid.” But the data isn’t just pulled out of the air and made up on the spot but there are things that... if you studied the campaign you would know that things just didn’t work that way.... I want the game to be fun but I also want it to be believable and realistic...I think that’s the highest art and the designer is somebody who can conceive of a way to model something that is realistic but at the same time its comfortable or easy to assimilate and to use, so that it’s fun when you’re doing it. It’s not a struggle. It’s not like doing higher math. Respondent #14

My goal is to try to be as objective as possible while still keeping with the goal that the game is the thing and the entertainment as the ultimate. So as soon as a thing hits entertainment, that [thing] has to die but to, up until that point then, we try to be as objective as possible. For a lot of different reasons...players don’t like feeling like they’re overly manipulated. They like to be able to come to their own conclusions. Respondent #11
Development Emphasis: Tolerance for the Iterative Design Process

Iterative design is necessary in order to ensure a product will be fun.

There’s obviously some pre-planning that goes into anything. We write a lot of specifications. And that’s kind of what I would call pre-planning. And then the iterative process comes and...the main thing I can think of right off the top of my head is just game play. So you may...create something and then when its basically play tested...find out that its not compelling...It doesn’t work properly as you intended and so you iterate that to...get the solution that you really wanted to get....You’re first idea may have sucked and you may want to iterate...and come up with a better idea...that works better. Respondent #18

You have to...have a more concrete target but I think its unrealistic, to micro-detail out that side because flexibility is really key in making a good game. I think most games are made, especially if they’re novel, if they’re following up other games that have been made, and ... follow very closely a previous game, you can pretty much detail it out to begin with. But if you’re...cutting something new, its very hard to determine in advance what’s going to work and what’s not...you have to have a lot of flexibility. Respondent #7

Possible Remedies to Disjunctions

Most suggestions reiterated the need for the products to be highly motivating for the end-user and commercially successful for the developer.

Well I think the over-riding problem is the fact that they have different goal states. To me thats, by far and away blows away any other consideration, the fact that as a commercial game developer I’m trying to maximise my return on investment and there’s a certain amount of infrastructure depending on the company I’m working with in that could very well be the maximum return on investments depending on the experience of my team, and etcetera, etcetera...tells me that I should spend three million dollars developing a product and hope to sell 500,000 copies...[That] is a totally different problem than an educational designer saying “I want to develop some technology to facilitate education in the school”...Probably the educator would not choose to spend three million dollars developing this when...probably hiring twenty teachers would do a whole lot more good than...putting it down the sinkhole of software development. So really one is almost an entertainment industry landscape and the other one is an instructional design landscape. Respondent #17

That depends on who’s funding...If you are hiring game developers to produce an educational product then obviously educational values win. If you are looking at working with game developers to produce a commercial product, it has got to be fun. If it isn’t fun, it’s not a commercially viable product. And that’s our number one concern. So really the fundamental rule is the golden rule, he who has the golden, rules. So if someone had a grant to do educational software and wanted to hire game developers to develop it then the biases required by the grant...win. If someone is trying to put a commercial product on the shelves and it’s not specifically an educational product, and actually even it is, its still gotta to be fun first. Respondent #3

The designer himself is always trying to make as much of an interesting, stimulating and fun product as possible. But the key word...influence behind game designer is the executives and they want a product that will sell, so I think it comes down to business...The educational facilities
are more interested in providing something that will educate the public or their student bodies and they’re not as influenced by money or time-frames that... It would be difficult to really say what would pretty much be a good medium. I couldn’t tell you. Respondent #8

Other remedies to possible disjunctions between game designers and professor/instructors referred to the communication dynamics between members of the development team.

These responses emphasized recruiting team players, mutual respect, keeping an open mind and striking a balance between the two perspectives.

Picking the people that are going to do this very carefully is important. Picking people that are willing to be very open minded and willing to be productive in working toward developing a product is going to be very important. Respondent #6

The problem I see is most game designers are going to want to play up the fun factor as opposed to learning. At least that’s my impression from talking to my friends who are designers. That’s not very scientific. Whereas I would think that the professors would want to stress education over anything else. So the key is going to be to strike a balance. Like I mentioned earlier with my company, they do a lot of the self-learning things which isn’t really intentional. It just so happens that our boss, our president his big bugaboo is historical accuracy. So...the historical facts and figures and...calibres, population numbers all that type of thing ends up in the game anyway, because that’s what he likes. In the end it comes out to a nice blend where while you’re playing you might not realize that...you might learn something about Napoleon that you wouldn’t have thought before hand. At the same time you’re having a great time. So I think if they can strike a blend where they include the learning but they don’t beat you on the head with it, and you have fun but you still pick up the learning that you need, that’s going to be the best thing. Both sides will have to compromise. Respondent #22

Remedy: “No” to buying-in to the vision

Given the complexity, cost and challenges of software development, it was surprising that several very experienced designers indicated a significant commitment to be open to ‘discovering’ a vision as the team proceeded through the development process.

Well I don’t think they’re going to afford the luxury of ‘buy’ something together. I think they’re going to be ‘put’ together, and have to work it out from there. And to say, “Oh we don’t buy-in to the same vision therefore let’s not work on this project,” won’t happen. I think if that was to happen a lot of companies would be out of business because no one would be working together. People are going to be forced into a situation to work together and during the development process they might never share the same vision. And the compromise that they will reach or not reach, (laughs) which a lot of us have experienced, the compromise or the target or the vision, that both people need to have... has to be very simple, that people will want this, people will play this because they want to. And what ever they get out of it, how much, how little, is something up for debate. That won’t ever be agreed upon by the any people. But simply make it something that is aimed for a non-captive audience, that’s something that’s fun, that has a lot of replay value, and cause and effect are obvious. Respondent #12
Well I don’t see how they could buy-in to the same vision from the outset. They would have to work it out... there’s some contention over the best way to do that. Where I work here the tendency is towards a more committee approach and a desire to gain consensus on new products. That’s the way we’re approaching them. My personal feeling is that doesn’t work very well in the sense of too many cooks spoiling the broth...I think its better that there be one, or at most two or three people that work really well together, and have a very strong vision of what they want to achieve. Or that person writes out a fairly extensive design document and solicits feedback from team members more on an individual basis rather than in a group setting, and tries to incorporate that feedback in that way. And this is just my personal opinion, I think stronger products are done that way. You spend less time flailing about, sorting out differences of opinion because in that group setting you also have to deal with a lot of social dynamic issues, of the people who are aggressive about their opinions and forceful in arguing their case. Versus the people who actually have better ideas but they’re shy in a social situation, so they don’t say anything. And I think if you have one person who is appointed as the design lead and that person doesn’t have too much of an ego...but can go and talk to people. They have to have a good vision themselves of what they want to do but then they have go bounce that off of everybody in turn and make sure that they’re not going down any blind alleys or they haven’t overlooked some internal contradiction, that kind of thing. Respondent #14

One respondent stated that ‘buying-in to a vision’ was an issue too dependent on many other factors and therefore was too ‘fuzzy’ to make a connection as a possible remedy.

Well I guess to me that vision is something that develops over time. Its not something ‘Day one we will have our vision.’ ‘Put the vision on the table.’ I think it’s more a direction...if they can decide on ... what the goals of the project is would be the first step and from that the vision would come. But ... I think the vision is going to be... its more personal chemistry...if you really think you can be accommodating and respect the other person and its not each person thinking ‘Oh its going to be my vision that wins and we’re going to have competing visions here.’ But if everybody involved says ‘...I’m going to have input into the vision here and so will other people.’ ... its all the same thing, its entirely dependent. It has nothing to do with team size, what the development structure is going to be. Its just one of those kind of fuzzy issues that I can’t give you a quick answer to.

Question: What do you mean by development structure?

Answer: There are a lot of ways you can go about developing a software, piece of software. You know you can write an entire spec and hand it to the development team and say see you in two years. The designers can be actually involved with the development process form Day One until ‘The ship [date]’, and the design can be evolving all the time. You can have one person coming up with the concept and another person that kind of slowly takes more into the implementation. You can have a team of designers that works the whole project through that actually divvies up the responsibility...which is kind of the way I’m working right now. I have two co-designers I’m working with and we will meet once a week and look at all the major issues. Usually about half the issues will be solved with us as a group and the other half will be divvied up amongst us to solve individually. So its...its, a pretty wide open space of...possible design approaches. Respondent #17

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