LEARNING TO PLAY: THE DESIGN OF IN-GAME TRAINING TO ENHANCE VIDEOGAME EXPERIENCE

by

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ABSTRACT

As the videogame industry continues to boom, the increase in production resources and game design experience has led to the development of increasingly more complicated games. Current videogames require the manipulation of complex physical and virtual interfaces. In-game training is now critical to the enjoyment of sophisticated and challenging game experience. The thesis first reviews the process of discovery that identified the types and capabilities of a variety of in-game training strategies. It then details the development and testing of an effective in-game training system that improves player performance without negatively affecting the experience of play. Two critical success factors are highlighted: the type of training and the timing of the training. Finally, the thesis positions games as examples of training systems that effectively engage users, and therefore as sources for educational design concepts that can increase our potential to make learning a truly rewarding experience.

Keywords: training; videogames; play; learning; game design; instructional design

DEDICATION

This thesis is dedicated to my wife, Erica, and every other non-gamer who struggles to understand why videogames are fun. Not everyone can pick up and play a game well – especially if it is a videogame. Nonetheless, most videogames are designed with the intent of enabling people to have fun. This paradox is what inspired me to look at this problem deeper and find solutions that help new players discover the joy that can be had with videogames. In-game training is a necessary part of learning how to play games. As a 'gamer', it is my hope that through this research, new instructional methods will be developed that can further expand the videogame audience and allow gamers to share their experiences with friends they may not have been able to in the past.

ACKNOWLEDGEMENTS

The thesis that follows is by no means the work of one. Rather, it is a story written from my perspective about a quest for greater understanding. My version of the story began one year prior to the completion of my undergraduate degree at Simon Fraser University in Surrey. I found myself in a classroom asking whether it all really had to end within the next year. Not long after asking myself, I posed the question to my Professor and mentor, Jim Bizzocchi, who was responsible for orchestrating the events that led to this thought-process.

It was in that fourth-year game design course that I realized what I was made to do. Sure enough, I was fortunate enough to gain the acceptance of Dr. David Goodman, and I began developing games in the Motor Behaviour Lab at SFU. These two men, each in their own unique ways, were responsible for the series events that would follow. To them, I am extremely grateful.

The story continues and I found myself working on a game called *Symptom Shock*. The game went through much iteration, and I am thankful for Nori Bradley, Erica Moore (who would soon become Paras), and Ian Williamson for their influence on the game. It was through the research done on *Symptom Shock* that I would discover *my* research question.

Under the financial support of the CIHR and the Motor Behaviour Lab, I would eventually begin my own research on a game called *Heads Up Hockey.* Around the same time, I was accepted into the graduate program at SIAT where I began my studies. Though I learned from many while undergoing the course-work portion of my graduate degree, I must thank Dr. Janet McCracken, Tracey Leacock, John Nesbitt, and Jim Bizzocchi for their influential instruction and direction. Without them, I would never have formed my research question.

Work continued on *Heads Up Hockey*, as Chad Ciavarro, Aaron Wylie, Craig Huff, Glendon Holst, and I began putting the finer pieces of the game together. I am grateful to these individuals for their dedication to make the game what it is today – a quality piece of work that played an instrumental part in the data-collection phase of my research. Special thanks go to Chad, who deciphered my pseudo code and implemented the in-game training system.

When everything was ready to go, I took ten laptops with me and began my experiment. I must thank Jill Meanley, who communicated with the schools and worked her hardest to ensure that everything went smooth during the testing. When the data had been collected, I turned to my wife, Erica, for statistical support. Thank you for helping me to understand properly what it was I was looking at.

With the work behind me, I began to write…and write. Again, I must thank Jim Bizzocchi, Dr. David Goodman, and my wife for believing in me and providing the support that I needed to reach the goal. The story has not ended, nor will it for a long, long time. However, this chapter is complete and the characters above are those who shared their lives to make it what it is.

“Daring ideas are like chessmen moved forward. They may be beaten, but they may start a winning game.” – Goethe.

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GLOSSARY

Before-play	Refers to training that occurs prior to gameplay.
Flow	The state in which a person is so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that he/she will do it even at great cost, for the sheer sake of doing it.
Game	A system in which players engage in artificial conflict, defined by rules, that results in a quantifiable outcome.
Gameplay	Includes all player experiences during the interaction with game systems, especially formal games.
Genre	A class or category within which a videogame fits. Different sets of genres are used interchangeably among videogame journalists.
In-game	Refers to any instruction or training that occurs within the virtual confines of the videogame.
In-play	Refers to training that occurs during gameplay.
Magic Circle	The space within which a game takes place. The space is defined by the rules, environments, and players engaging in the game and is both limited and limitless.
Player	A person who interacts with a game.
Videogame (Electronic game)	Refers to a game played on an electronic device with a video display.

1 INTRODUCTION

As the videogame industry continues to boom, increasing resources and experience have enabled game developers to develop increasingly more complex games. In contrast to early videogames, modern videogames require the manipulation of complicated control interfaces and in-game interfaces. Nonetheless, players thrive on these types of videogames and continually demand for more. Though not all games are extremely complex, all require that the player understand how to play them. Successful in-game training is the key to creating videogames that are challenging, rewarding, and void of frustration. In this thesis, I will discuss the process that I underwent to discover why in-game training is so important and how to develop an in-game training system that improves player performance without negatively affecting the experience of play.

The influence of videogames on today's children is undeniable (Mitchell & Savill-Smith, 2004; Kirriemuir & McFarlane, 2004; Entertainment Software Association, 2006). I was involved in a multi-year CIHR grant[1] that addressed the teaching of concussion-related material to youth by use of videogames. Rather than employ traditional forms of instruction such as print or video, videogames were developed to capture the interest a specific demographic – youth hockey players. Knowing full-well that a good portion of this demographic spends

[1] Canadian Institutes of Health Research, Grant# CAR-42272, D. Goodman, P.I.

significant time playing videogames, the intent was to develop videogames that positively influenced their personal health and well-being as hockey players.

With my focus on developing effective educational games, what I would discover revealed to me a significant problem that should be dealt with when developing games of any sort. Before learning the content embedded within an educational game, it is necessary that one understands how to play the game. As players began to interact with our first educational game, *Symptom Shock*, it became clear that it was difficult to understand the controls and mechanics of the game, let alone the concussion symptomology information embedded in the gameplay.

As the developer of *Symptom Shock*, I was involved with every step taken to make the game easier and more fun to play. *Symptom Shock* employed a number of instructional methods, each seeming to have some effect on player performance. The primary reason for improving the instruction was to minimize the barriers blocking the player from engaging with the educational content. While the experiments performed with *Symptom Shock* showed increased gameplay and questionnaire performance for those who underwent interactive training, I was left wondering what other approaches could have been taken since we had done little research in this domain prior to selecting the methods implemented for *Symptom Shock*.

When developing optimal instruction for videogames there are two factors that should be considered: the type of training (delivery method) and the timing of the training. Together, these form the basis for the game's instruction. After reviewing nearly fifty videogames, I formulated a hypothetical methodology for evaluating and developing effective training in videogames. My experiences with these games revealed that in-game, situated training appeared to the most effective since it enabled me to quickly jump into the 'magic circle' (Salen & Zimmerman, 2004) of the videogame environment without ever becoming overly anxious or frustrated.

In the chapters that follow, I discuss how games share many of the same properties of effective training practices. Games are good examples of training systems that effectively engage users and make learning a truly rewarding experience. In Chapter 3, the results and observations from our studies with *Symptom Shock* are presented. This forms the discovery of the research question – can training that exists *during play* increase player performance without jeopardizing the player's experience?

Chapter 4 introduces the game database that was created to collect information about other in-game training systems that have been developed by professional game designers. In this chapter, I methodically break down the instructional systems within the observed games and present a systematic methodology for describing and creating training systems for videogames.

Chapter 5 describes a study that assesses the impact of a context-sensitive in-game training system on player performance and enjoyment. In this Chapter, I challenge my hypothesis by testing a group that was exposed to training before-play and a group that exposed to training in-play against a control group. The results from this study and specific design principles are discussed and presented in Chapters 6 and 7. Finally, in Chapter 8 I present a summary of my findings and further research that, if performed, could be of significant benefit to the game industry.

2 LITERATURE REVIEW

2.1 Introduction

The act of learning is an important and sophisticated phenomenon. As our collective knowledge increases, we continue to discover new ways of increasing our ability to know, comprehend, apply, analyze, synthesize, and evaluate information (Bloom, 1994). Whilst some of these discoveries are clearly beneficial, other methods of learning are not as practical and should be evaluated to ensure both effectiveness and efficiency. For centuries, games have been used to enhance learning because of their innate ability to engage players into a performance they might not otherwise participate in. Now, instructional designers must consider the introduction of videogames, which have taken pop culture by storm and achieved popularity levels similar to other major players in the entertainment industry such as film (Vincent, 2004). Conversely, games must consider effective instructional design. As they become more complex, games require greater cognitive and physical skills, and effective training is necessary to develop these skills in players.

Before engaging in the subject of games and learning, one should have a solid understanding of both game design and instructional design. Videogames carry with them a number of unique properties that separate them from traditional games. Though games, whether on the schoolyard or in the living room, have always been a part of our lives, videogames now provide new capabilities that are not possible without digital technology. Janet Murray (1997) points out that digital environments are characteristically procedural, participatory, spatial, and encyclopedic. The successful integration of these properties with game mechanics creates a "magic circle" (Salen & Zimmerman, 2004) for players to enter where they can become so deeply engrossed that outside things do not distract (Csikszentmihalyi, 1990). These engaging characteristics of transformative play are what instructional designers hope to achieve in their development of educational experiences.

2.2 What Are Videogames And Why Do People Play Them?

The concept of 'game' stirs up a wide array of emotions. To some, 'game' reminds them of their childhood spent with their friends. To others, 'game' may remind them of the time their favourite team outdid all odds and won the divisional title. In some circumstances, 'game' might bring negative memories of despair due to the consequences of losing. Whatever feelings are aroused, games are a dynamic part of nearly every person's life.

2.2.1 What Defines a 'Game'?

In an attempt to provide a robust definition of 'game', Katie Salen and Eric Zimmerman (2004) looked at eight different definitions of game as provided by game historians and designers. They then deconstructed their definitions and isolated specific characteristics that were common to most or all of the definitions. They used their shared characteristics to construct a composite definition that reflected much of the best critical thinking in the history and theory of game design. The result was the definition of game as, "a system in which players engage in artificial conflict, defined by rules, that results in a quantifiable outcome." (ibid). When we establish goals and attach artificial conflict, we are indeed creating games within which we can either fail or succeed. This opportunity for failure and success provides players with challenging, engaging experiences.

There are many different types of games. Among the obvious types are sports games, board games, schoolyard games, and mind games. The medium of each of these game types has a significant impact on the capabilities of their systems. Sports games often include uniforms and equipment, as well as referees to help establish the rules. Board games often create artificial spaces within which players can interact. Schoolyard games test a child's motor skill abilities via interaction with playground facilities. Mind games challenge a player in the conceptual models we as humans have created and defined. The environment in which one plays the game also serves to limit what is possible. For instance, you will probably never see a racing sport where the player's primary objective is to use his car to flip his opponents, and if flipped, continue racing to the finish. Yet, this is indeed possible in videogames (*Burnout 3: Takedown*, Criterion Games, Electronic Arts, 2004). No matter how hard a player pushes the limits, sports games are limited by physics and the reality that even though they are engaging in an artificial conflict, there are still real consequences.

2.2.1.1 Rules, Play & Culture

Salen and Zimmerman (2004) look very closely at game design and break down the subject area into three separate schemas. Using these schemas as a framework for both describing and developing games, game designers are able to develop games that promote 'meaningful play'. According to Salen & Zimmerman, "the goal of successful game design is the creation of meaningful play."

The first schema is **rules**, which is a *formal* primary scheme that focuses on the intrinsic mathematical structures of games. Rules limit player action, are explicit and unambiguous, are shared by all players, and are fixed, binding, and repeatable. The second schema is **play**, which is an *experiential* primary schema that emphasizes the player's interaction with the game and other players. The concept of play will be described in detail below. The final schema is **culture**, which is a *contextual* primary schema that highlights the cultural contexts into which any game is embedded. Games reflect culture, reproducing aspects of their cultural contexts. Some games also transform culture, demonstrating play's ability to alter the more rigid cultural contexts in which the game is taking place.

2.2.2 Videogames: A New Medium – A New Type of Game

Over the past thirty years, games have benefited from a new medium that has enabled us to re-define the environments within which games take place. While in the past we may have been limited by the pre-written rules of physics and temporality, computing technology allows us to more broadly define the spaces that our games exist in, enabling greater freedom and innovation.

Videogames have experienced phenomenal success. In 2003, the videogame industry accounted for $11 billion in the US. As a relatively young medium, videogames are continuing to grow rapidly and greater numbers are expected in the future. Among young boys, videogames have taken the top spot above traditional toys such as action figures (Game Infowire, 2004). However, contrary to popular belief, videogames are not just for kids. A Los Angeles reporter explains how older gamers continue their interaction with videogames into their 30's and 40's (Colker, 2004). In the report, president of marketing for EA, Frank Gibeau explains that, "Once you get into games, you stay with it. You give up other things if you like games -- you give up TV, you give up reading, maybe."

The videogame industry has very devoted fans. When *Halo 2* (Bungie Software, Microsoft, 2004) was released, it was expected to break records with its 1.5 million pre-orders. The game ended up selling nearly 2.5 million units in its first 24 hours, grossing roughly $125 million (Design Technica, 2004). *Halo 2* generated more money for Microsoft in its first day than the biggest movies in box-office history, causing it to be considered by many as a "pop-culture phenomenon".

2.2.3 Properties of Videogames

Videogames are different from any other type of games. While they share many of the same elements with their non-digital counterparts, videogames have a number of special abilities that help to establish a magic circle for the player to enter and become engrossed in. Since videogames are code driven and have internal structure, events within the games happen procedurally (Murray, 1997). In comparison to film environments, videogames allow participation with the environment and other people in the environment. Videogames are spatial, providing the player with new environments that are rich in graphical and audio content. The spatial property of games helps the player suspend disbelief and become an agent in the game world. Videogames are also very encyclopedic. In contrast to many other types of games, videogames access vast databases of information to provide rich, emergent game experiences.

These properties work together to immerse the player. While immersed in the game world, “We do not suspend disbelief so much as we actively create belief” (Murray, 1997). The act of playing a videogame requires the player to imagine him or herself in the environment and make appropriate decisions for any given situation. The cognitive engagement of playing videogames is often quite high and requires the player to share from previously developed conceptual models. Since videogames can provide a wide variety of interactive outcomes, the player can see the experience as approaching real-life situations. Many challenges presented in videogames encourage the player to draw from real-life experiences in order to succeed.

Espen Aarseth (2004) is clear to point out that the name ‘videogames’ is a bit deceptive. Aarseth explains that the field of digital games has two main categories: 1) digitized versions of traditional games and 2) games in virtual environments. He asserts that this medium known as “videogames” should instead be called “games in virtual environments”. When we talk about videogames, we are indeed talking about games in digital/virtual environments. Just as sports can be defined as "physical games in defined environments" or board games as "games on board spaces", videogames are a game type of their own that enable unique styles of gameplay.

To many game players, this understanding is transparent and well-known. Take, for example, *Half-Life* (Valve, Sierra, 1998) a videogame that is clearly a game within a virtual environment. The objective in this game is to escape a nuclear facility that is on the brink of total destruction. The game has players, artificial conflict, rules, and a clearly defined quantifiable outcome. The *Half-Life* system is also a virtual environment. Thousands of players have engaged in their own videogame creation by modifying the game code and developing their own games within the *Half-Life* environment. However, a digital environment does not become a successful videogame just by using fancy graphics and sound. Clearly designed goals and objectives must be used in conjunction with the unique abilities of digital environments in order to create successful videogames.

2.2.4 The Effect of Videogames

Many have considered the impact of videogames and their ability to draw players in. Among the primary issues of concern are addiction (see *http://www.olganon.org/*) and violence (Deselms & Altman, 2003; Malliet & Mayer, 2003). Because of their immersive properties, videogames have the innate ability to transform the player through the experiences felt during gameplay. This transformative ability is a factor that elicits both fear and hope in those that study the effects of game play.

2.2.4.1 Transformative Play

In *Rules of Play* (2004), Salen and Zimmerman go into great deal to explain the concept of 'play'. In short, "Play is free movement within a more rigid structure." Within play are three separate categories: gameplay, ludic activities, and being playful. Gameplay is the most formalized of the three, existing within the experiences of ludic activities and being playful. By design, videogames allow their players agency (Murray, 1997) and freedom within a defined rule set. Salen and Zimmerman explain that, "when play occurs, it can overflow and overwhelm the more rigid structure in which it is taking place, generating emergent, unpredictable results." When changes in this rigid structure occur, *transformative play* takes place.

Transformative play is an important concept because it reaches at the heart of the many social issues concerning games. The transformative nature of gameplay is where the power of videogames is manifested. If games can change people's thinking, what impact do the games that children are playing have on them? The impact is not always considered negative. Game academic, James Paul Gee (2004) provides an alternate side to the issue.

> "In the end, I have to admit, though, that I believe game designers can make worlds where people can have meaningful new experiences, experiences that their places in life never allow them to have or even experiences no human being has ever had before. These experiences have the potential to make people smarter and more thoughtful."

Gee argues that the transformative characteristics of gameplay inherent in videogames are in fact the result of good design. He explains that players within games learn and conquer extremely difficult tasks without any extrinsic motivation. Designers of good games have hit on profoundly good methods of getting people to learn and to enjoy learning (ibid). The existence of transformative play in videogames plays a significant role in their successful ability to entice players and transform their thinking.

2.2.4.2 Flow

When players play games, they often become so immersed in the gameplay that things happening outside of the game do not distract. This phenomenon is known as *flow* (Csikszentmihalyi, 1990). As a psychologist, Csikszentmihalyi spent much of his time trying to understand how people felt when they most enjoyed themselves, and why. He defines flow as the state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it.

During the course of his research, Csikszentmihalyi discovered activities that most consistently produced flow. Among these activities were sports and games. According to Csikszentmihalyi, the conditions for flow require an experience where the participant's skill is closely matched to the challenge of the activity. In game terms, the objective should be challenging, yet feel as though it is just within reach so that the player does not feel anxious. Conversely, the objective should not be too easy as to bore the player. These design attributes have been a part of games since their beginnings. Even the videogame *Pong* (Ralph H. Baer, 1966) applies these fundamental attributes by becoming increasingly more difficult as the player's skill improves. When the player finally loses in *Pong*, replaying the first few levels is extremely boring because their skill does not decrease. Modern day games such as *Half-Life 2* (Valve, Vivendi Universal, 2004) automatically create restore points along the way so that challenge is always optimized.

Flow derives from activities that provide enjoyment. To be enjoyable, an activity must meet one or more of the following eight components (Reiber, 1996).

1. Challenge is optimized
2. Attention is completely absorbed in the activity
3. The activity has clear goals
4. The activity provides clear and consistent feedback as to whether one is reaching the goals
5. The activity is so absorbing that it frees the individual, at least temporarily, from other worries and frustrations
6. The individual feels completely in control of the activity
7. All feelings of self-consciousness disappear
8. Time is transformed during the activity (e.g. hours pass without noticing)

Upon review of these components, it is no wonder why good games are so enjoyable. Greg Costikyan illustrates in *I Have no Words & I must design* (1994), some keys to creating good games. Games should have decision-making, goals, opposition, resource management, game tokens, and information. While these do not all speak to the experience of the player, they coincide with some of the components of enjoyable activities such as challenge, clear goals, feedback, and control. Since good videogames share many of the components that make for enjoyable experiences, they are very effective at bringing the player into a state of flow.

2.2.4.3 Motivation

Games are highly motivating. Since most players play games solely for the sake of playing, games can be thought of as intrinsically motivating. This is perhaps counter-intuitive since some games provide extremely difficult challenges with no material reward and yet they remain highly motivating. Gee (2003, 2004) suggests there is something about how games trigger learning that makes them so deeply motivating. While playing games, players often feel like they are accomplishing tasks and learning new skills. Whether they are progressing through a game narrative or taking on more sophisticated artificial intelligence, players must learn new skills and apply them as they learn them. In classroom learning, there is often a disconnection between when something is learned and when it can be applied. However in games, players are instantly rewarded for learning and therefore games are highly motivating for those who play them.

2.2.5 Summary

People play videogames because they provide the opportunity to learn new skills and apply that which they have learned in challenging, immersive environments. As an entertainment medium, videogames take the next step in enabling players to suspend disbelief. Prior to the introduction of highly realistic videogames, film was considered the most immersive experience of an alternate reality. Now, with highly adaptive and visually realistic game environments, players can engage in challenging activities and narratives that give them the opportunity to actively create belief. As the primary goal of game design, meaningful play (Salen & Zimmerman, 2004) can affect the cognitive space of a player and allow for engagement in activities and experiences that were once only possible in his/her dreams.

2.3 Principles for Instructional Design

It is important that we continue to develop new and improved ways of delivering instruction. Fortunately, game designers have a lot to teach us about instructional design. If games did not effectively teach their players how to act within their artificial environment, players would begin the experience feeling lost and ineffective. This is not the case, and games use very effective ways of teaching (Gee, 2004). This review will look at some well-known learning styles, pointing out how videogames actively and successfully apply these styles of learning.

2.3.1 Behaviourist Stimulus Response

On a very basic level, videogames apply behaviourist stimulus-response theory in their designs. Skinner's ideas concerning operant conditioning address two main types of learning: positive reinforcement and negative reinforcement (Bower & Hilgard, 1966). Videogames often use both types of reinforcement to ensure that players learn. Of primary usage, though, is positive reinforcement where the player is rewarded for doing something correctly. In many games, correctly achieving a goal will result in rewards such as power-ups (increased ability for the avatar that the player controls), advances in the narrative, or in-game tokens. Videogames apply such structure on almost every level. Meaningful play requires discernable and integrated play (Salen & Zimmerman, 2004). If a player performs an action, they should reap the rewards of that action both immediately and later on. Discernable interaction helps the player to learn more quickly by constantly and consistently providing feedback on the choices that they are making.

Such learning principles are important in instructional design. Games implement reward structures that entice the player to perform at their best. For example, In *Burnout 3: Takedown* (Criterion Games, Electronic Arts, 2004) and *Need for Speed Underground 2* (Electronic Arts, Electronic Arts, 2004), the player is able to win special vehicles that they can use in game. Rather than conceal this information from the player, silhouettes of the cars create tangible stimuli. Objectives are often quite clear. To reap a reward, the player is instructed in what type of response they must perform. Continuous stimulus and response interaction encourages the player to learn and advance their skills.

2.3.2 Bloom's Taxonomy

First introduced in 1956, Bloom's taxonomy has found itself used by many instructional designers as a tool for developing assessment (Bloom, 1994). Bloom and his colleagues devised a 6-point hierarchical approach to classifying educational objectives in the cognitive domain. The hierarchy begins with knowledge, and then proceeds with comprehension, application, analysis, synthesis, and evaluation. For a learner to operate in any of the categories, he/she must have mastered the previous categories. Each category contains key words that help to describe the educational objective of concern.

Marc Prensky (2002), a researcher in games and learning, explains five “levels of learning” in videogames. These levels depict the types of things that players of videogames might learn while playing. The table below illustrates similarities between Prenky’s Five Levels and Bloom’s Taxonomy (Table 2.1).

Table 2.1: Bloom’s Taxonomy & Prensky’s Five Levels of Learning in videogames

Bloom’s Taxonomy	**Prensky’s Five Levels**	**Learning**
Knowledge/Application	Learning How	The **moves** of the game
Knowledge/Comprehension	Learning What	What to do in the game - the **rules** of the game
Analysis	Learning Why	The **strategy** of a game
Evaluation	Learning Where	**Contextual** information about culture and environment
Synthesis	Learning When/Whether	**Decision** of right or wrong

Games successfully take learners through the five levels that Prensky describes. Whenever one plays a game, learning happens constantly, whether the player wants to, or is even aware of it (Prensky, 2002). While describing his model, Prensky illustrates the many skills that kids can learn while playing videogames (Table 2.2).

Table 2.2: Skills that can be learned by playing videogames

Hand-eye coordination	Safety
Physical manipulation of controllers	Strategy in sports and business
Pattern recognition	Long term winning versus short term gains
Mental spatial processing	Order from seeming chaos
How to parallel process and multi-task	Second-order consequences
How to incorporate peripheral information	Complex system behaviours
How to use/manage a large database of information	Using obstacles as motivation
The skill of inductive discovery	The value of persistence
Physics	Cultural metaphors and images
Human behaviour	How to handle cultural relativity
How to deal with other people	How to deal with different people and roles
Squad-based teamwork	Leadership

Found in *What Kids Learn That's POSITIVE From Playing Video Games* by Marc Prensky (2002).

Instructional designers and game designers tend to work in different worlds, and the lack of a shared language between the two sides often makes it difficult to classify learning in games. Prensky's model provides a clearer picture of the learning that takes place in games, and research in applying Bloom's taxonomy to commercial games shows that games do teach and taxonomies such as these can be used to objectify the learning that takes place (Leacock, Paras, & Bizzocchi, 2004).

2.3.3 Situated Learning

Under the helm of constructivist thinking, Brown, Collins, and Duguid (1989) explain that learning and cognition are fundamentally and that situations might be said to co-produce knowledge through activity. Therefore, they argue the importance of learning in situ, claiming that people who use tools actively rather than just acquire them, implicitly build an increasingly rich understanding of the world in which they use the tools and of the tools themselves. The learning experienced is greatly enriched through the active situated learning experience.

The role of videogames in situated learning is significant. Videogames and situated learning are related in two distinct ways: 1) games use situated learning to teach how to play the game, and 2) games are situated learning environments that teach real-world skills (Gee, 2003). The first application of situated learning is prevalent in today's videogames, which are encyclopedic environments (60+ hours of gameplay) that include a vast variety of skills that must be learned in order to play. To teach every skill to the player before they begin playing would not only overwhelm them, but it would ruin many of the surprises later on in the game. Learning such skills is one of the aspects that makes many of these games exciting. Games now take a situated approach to instruction. For instance, *Grand Theft Auto: San Andreas* (Rockstar North, Rockstar Games, 2004) is a massive videogame with hundreds of mini-games embedded within its digital environment. Each skill, whether it be walking or landing an airplane, is taught in-context. In this way, the skill is relevant to the current situation and the learner can instantly apply what he/she has learned.

The second way in which videogames are related to situated learning - the teaching of real-world skills - is important to instructional designers. If learning in authentic, situated learning environments is so important, teachers need a practical way for students to engage in such learning. Videogames provide a limited, but improved opportunity for situated learning. By enabling learners to participate in immersive experiences, 3D learning environments could help students develop a deep, experiential understanding of highly complex biological, electronic, or mechanical systems (Bares, Zettlemoyer, & Lester, 1998). Because videogames are games, they also benefit from the motivational ability inherent in them (i.e. kids enjoy videogame play). As goal-directed situated learning environments, videogames possess the potential to become highly effective tools in learning.

2.3.4 Learning Environments

Effective learning environments are an important aspect of learning. There are recognized similarities between the design of games and the design of educational experiences. In *Things that make us Smart*, Donald Norman (1998) identifies seven basic requirements of effective learning environments:

1. Provide a high intensity of interaction and feedback.
2. Have specific goals and established procedures.
3. Motivate.
4. Provide a continual feeling of challenge that is neither so difficult as to create a sense of hopelessness and frustration, nor so easy as to produce boredom.
5. Provide a sense of direct engagement, producing the feeling of directly experiencing the environment, directly working on the task.
6. Provide appropriate tools that fit the user and task so well that they aid and do not distract.

7. Avoid distractions and disruptions that intervene and destroy the subjective experience.

These specifications closely match the design of most videogames. If content were properly integrated within videogame environments, the result would likely be effective, highly motivational learning. Since the requirements that Norman lists match closely to games, instructional designers should look to games as examples of these principles in action. Should they be able to integrate them into their classroom, students might become more motivated to engage in the material.

2.3.5 Constructivist Learning

Constructivist learning designs have a number of key characteristics that enable meaningful learning to take place (Jonassen, 2003). These characteristics also resemble those of videogames.

- Active - Learners are engaged by the learning process in mindful processing of information where they are responsible for the result.
- Constructive – Learners integrate new ideas with prior knowledge in order to make sense or reconcile a discrepancy, curiosity, or puzzlement.
- Collaborative - Learners naturally work in learning and knowledge building communities, exploiting each other's skills while providing social support, and modelling and observing the contributions of each member.

- Intentional - All human behaviour is goal directed.
- Complex - Problems are multiple components with multiple perspectives and cannot be solved in predictable ways like the canned problems at the end of textbook chapters
- Contextual - Learning tasks that are situated in some meaningful real world task are not only better understood, but also more consistently transferred to new situations.
- Conversational - Learning is inherently a social, dialogical process.
- Reflective - Learners should be required by technology-based learning to articulate what they are doing, the decisions they make, the strategies they use, and the answers that they find.

Many successful commercial games employ these strategies in their design. The benefit of using the videogame medium for this type of learning exists in its computing power. Videogames can offer environments that fill all the requirements listed above, requiring no external human intervention.

2.4 Where Should Games Exist Within the Domain of Learning?

2.4.1 Playing to Learn

If games and learning are so complementary, we are left to wonder why educational gaming has not become a booming success. What neither researchers nor educational game-developers have so far been able to do is to create an 'educational game' that offers its players the kind of engaging, immersive play-space in which users want to stay, explore, and learn, as they do consistently in commercial games (De Castell & Jensen, 2003). A number of barriers to entry must be understood before they can be overcome. First, the development of competitive videogames is very expensive. Games developed under educational funding often lack the resources to compete against commercial games in creating immersive and encyclopedic environments.

Second, the deployment of educational games has been limited to classroom settings. Not only is this very expensive, it also makes the experience of play non-consensual – students 'play' them because they are told to, the rule system is not one that they have agreed to, and so the constraints of the game do not become something to play within, but something to fight against (De Castell & Jensen, 2003).

Though games may not become an integral part of learning within classroom settings, kids already learn a lot while playing games at home. The content, however, does not relate directly to that which they learn in the classroom. Until commercial games employ content that is relevant to younger audiences, or educational game designers begin creating games that are comparable with commercial games, the power for games to teach will not reach its full potential.

2.4.2 Learning to Play

Games are massively complex, interactive spaces with seemingly unlimited interactive possibilities. Learning to play a game can be a rewarding experience. However, since the state of flow requires balance between skill and challenge, it is important that players be provided with adequate skills to succeed at any time in the game. If this is not achieved, most players quickly become anxious and will eventually lose interest in the game experience.

In-game training is an important part of nearly every videogame. To prevent players from becoming anxious, it is important that games employ effective teaching strategies within the gaming environment. Adapting a strategy that is simple to produce, transparent to the player, and effective at teaching the player, can have a huge impact on the game's enjoyment level and overall success in the marketplace.

Game developers know that game manuals are often completely ignored by videogame consumers. In contrast with paper manuals of the past, most game publishers now provide only a brief overview of the control schematics and the navigation the primary user interface. Beyond this, learning about how to play is incorporated within the game itself. This is due to the mentality of publishers, which is, "If the gamers aren't using it, then why waste resources producing and printing it?" As opposed to the one time production cost of in-game training, each printed manual costs the publisher and reduces the overall profit margin. It is also important to realize that reading a manual is not always the best way to learn how to play a game. Games require sophisticated interaction and deep understanding of specific environments and the actions that can be performed within them. Sometimes reading a book cannot effectively teach these skills.

2.4.2.1 Why is Training How to Play Important?

Before learning about methods of enhanced gameplay training, it is important to understand the significance of learning how to play games. A good game is easy to pick up, but difficult to master. To create games that exhibit these characteristics, one must minimize the functional and explicit interaction (Zimmerman, 2000) initially available to the player and maximize the integrated possibilities of what can be done with the simplified interaction set. This is exemplified in the city simulation game *SimCity 4*. For a player sitting down to play *SimCity 4* for the first time, the experience can be rather daunting due to the overwhelming complexity of the interaction possibilities available. Interaction possibilities must remain limitless or it would become too simple to operate the game as a city simulation game. However, limiting initial scenarios so that zoning and road placement are emphasized over procedures that are more complicated can make the game more approachable for a first-time player.

2.4.2.2 Addressing In-Game Training

To deal with the increasing complexity of videogames, gamers need improved mechanics for learning how to play so that they do not become overly frustrated by detailed interfaces and a multitude of interactive possibilities. Proper training can make a game that is otherwise difficult to master seem easy to pick up. During the short history of videogames, we've seen in-game training manifest itself in a number of different forms and developers are still exploring new ways to teach the player.

2.5 A Hypothesized Solution

If possible, learning how to play a videogame should take place within the gameplay environment. Unfortunately, creation of such systems is not always simple and not all games share the same benefit from this type of training Narrative-based games that are based on embedded linear interaction (Zimmerman, 2000) are more easily able to integrate a situated learning approach. At points in the linear story where players are required to perform new actions, such as how to drive a car, the game can easily determine that some form of training will help the player. This is a sound approach since teaching players skills that they can immediately apply is likely to result in learning that is more effective.

In more emergent gameplay, such as that of a sports game, the sequence of events cannot be so easily predicted and the integrated learning approach becomes more difficult to employ. In addition, the argument for using this approach cannot be as easily justified since players need a basic understanding of the game to be able to perform at all since the player is able to choose from a variety of interactive possibilities at any given time in the gameplay experience.

Nonetheless, if an integrated situated learning approach can be applied to emergent gameplay experiences, players might enjoy learning to play more if they are not required to spend anytime learning prior to playing. In the past, hockey videogames have relied on two approaches to in-game training. Some have used in-game training manuals, while others have used video demonstrations. None, however, has tried teaching players the skills of the game using a situated approach. If the situated approach can be demonstrated as an effective way of learning how to play in sports games, we can be sure that this approach is an effective, fun, and sensible way to teach players how to play games in general.

In this thesis, I will compare and contrast the use of two forms of in-game training in a hockey videogame to determine if a situated approach to instruction is suitable, even in sports games with embedded interaction. To determine this, I will test three different training conditions (1. No Training, 2. Before-play Training, 3. In-Play Training) and examine the effect on player performance. Using the Flow State Scale (FSS) (Jackson & Marsh, 1996), I will also look at how different training methods affect the players' ability to enter a state of *flow*.

3 DISCOVERING THE PROBLEM: *SYMPTOM SHOCK*

Over the course of two years, a number of studies/experiments in games and learning were conducted on a game called *Symptom Shock*. The primary goal of this research was to increase awareness of concussion symptoms within youth hockey players. By doing so, athletes may be better able to recognize when they are potentially suffering such an injury, which may result in increased player safety (Goodman, Bradley, Paras, Williamson, & Bizzocchi, 2006).

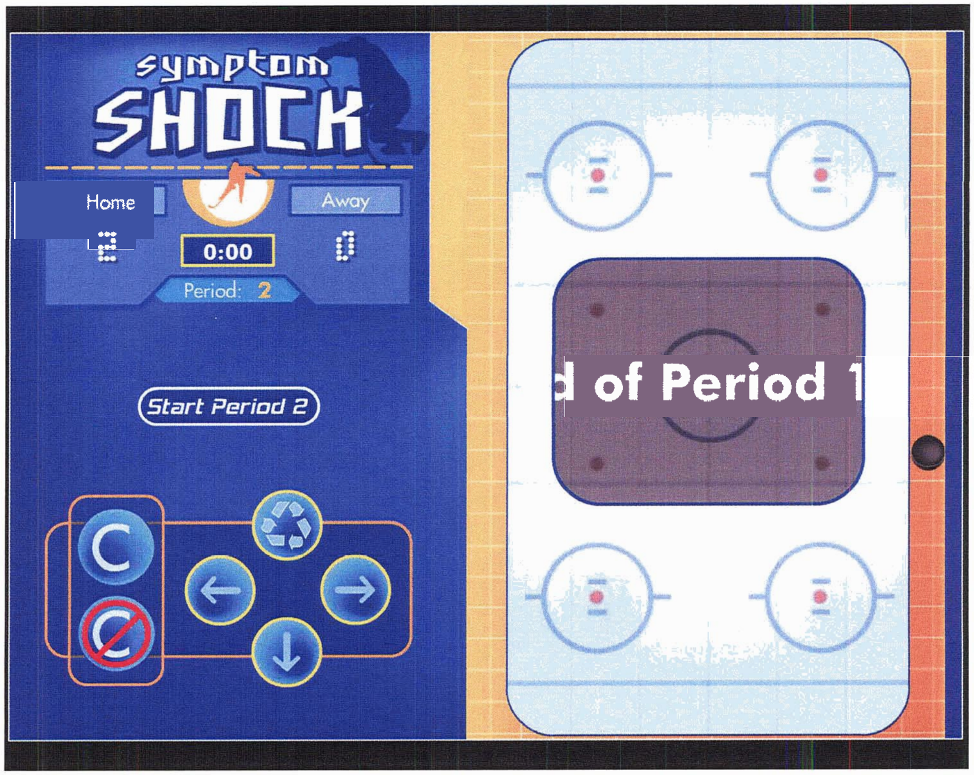
In contrast to exogenous fantasy, which overlays content on top of the fantasy (such as Hangman), endogenous fantasy is advantageous in that if the learner is interested in the fantasy, he or she will consequently be interested in the content. The fantasy within the world of *Symptom Shock* involves an artificial game of hockey where the player must compete against a computer opponent by strategically aligning groups of icons. The process of quick decision-making and timely execution is compelling and exciting to the player, and the game constantly adapts to the player's skill level, ensuring that flow state is achieved. To win the game, however, the players must learn about concussion symptoms and correctly identify them during gameplay.

Players who played the game gained a greater understanding of concussion symptomology and were able to respond to concussion symptom questions more quickly (Goodman, Bradley, Paras, Williamson, & Bizzocchi, 2006). All data was obtained electronically, which allowed us to track what was happening within the game and ask specific post-game questions about the usability of the game. Overall, players enjoyed the game. However, both player feedback and player statistics seemed to indicate that in one 20-minute sitting, it was difficult for the player to learn how to master the gameplay, let alone the educational content embedded within the game. This challenged us to look further into how we were teaching the game and the effect it was having on the learning experience as a whole.

3.1 The Game

The gameplay in *Symptom Shock* is somewhat similar to that of the classic game *Tetris*. To win the game, the player must score more goals than his or her opponent. To score goals, the player must move the puck toward the opponent's 'net' and align vertically falling icons to form combinations that allow the player to 'shoot'. The game is broken up into 3 periods and an optional overtime period if needed. The sound effects that complement the game are those you would hear if you were to attend an actual game of hockey, complete with skating, shooting, and hockey music. These familiar signs are used to represent the formal structure of the game that it represents – ice hockey (Figure 3.1). If the primary goal of *Symptom Shock* was merely to obtain a high score, rather than to compete against an opponent, the connection with the common signs that represent the actual game of hockey would be lost and the fantasy world that colours the gameplay would deteriorate.

Figure 3.1: *Symptom Shock* uses imagery that represents the sport of ice hockey



Screen capture, *Symptom Shock* (© David Goodman and Brad Paras, 2004, by permission).

3.1.1 The Formal Rules

3.1.1.1 The Objective

The objective of the game is to score more goals than your opponent does in the three, 1-minute periods by producing and labelling combinations of concussion symptom icons.

3.1.1.2 Play Area

- Play takes place on a grid of 6 by 10 squares.
- Four randomly selected icons appear at the top of the screen, randomly placed in 4 of the 6 spaces available.

- The icons fall square by square until they either reach the bottom of the “rink” or another icon that has already landed.
- Icons that land in the “No Stack Zone” are removed the instant they land.

3.1.1.3 Controlling the Icons

- The player can move the icons left and right by pressing the left and right buttons on the screen with the mouse or the left and right keys on the keyboard. Icons on the edge of the rink shift to the opposite side.
- If the player does not approve of the four randomly selected and placed icons, the player can press the “Randomize” button or the up arrow on the keyboard to reselect and place 4 new icons.
- The player can press the down button or the down key on the keyboard to speed up the descent rate of the falling icons.

3.1.1.4 The “Opponent”

- The puck on the right of the screen represents where play is taking place on the ice. If the puck reaches the top of the screen, the player scores a goal. If the puck reaches the bottom of the screen, the opponent scores a goal.
- The puck continually drops at a rate determined by the score. If the player is winning, the puck will drop faster. If the player is losing, the puck will drop slower.

3.1.1.5 Scoring Goals

- If a player detects three or more matching icons lined up either horizontally or vertically (a combination), the player has the option to decide whether the matching icons represent a concussion or a non-concussion.
- To identify a concussion symptom, the player must press the "Concussion" button or the A key on the keyboard. To identify a non-concussion symptom, the player must press the "Non-Concussion" button or the Z key on the keyboard.
- Correctly detecting and identifying a combination of icons moves the puck on the right of the screen up towards the opponent's net.
- Incorrectly detecting and identifying a combination of icons causes the whistle to blow and the puck on the right of the screen to move towards the player's net.
- The greater the size of the combination, the closer the puck will move towards the opponent's net.

3.1.1.6 Special Icons

- There are special icons that can affect gameplay.
- The Medic Icon will convert all eight spaces surrounding the icon as well as the icon itself into the same randomly selected icon.
- The Bomb Icon will eliminate all eight spaces surrounding the icon as well as the icon itself.

3.1.1.7 Winning the Game

- At the end of 3 periods, if the player has more goals than the computer then the player wins. If the player has fewer goals than the computer then the player loses.
- If the score is tied at the end of 3 periods, the game goes into Overtime. The first player to score a goal during Overtime wins the game. If the score is tied at the end of Overtime, the game results in a Tie.

3.1.2 Balance

In the development of *Symptom Shock*, two major constraints had to be dealt with in an effort to achieve the appropriate balance between challenge and frustration. First, the game had to be manageable for children aged 10-14. Second, the game had to be learnable within a 20-minute time-span. To make the game meaningful, however, a degree of complexity is required. With the use of intelligent programming, *Symptom Shock* is able to adapt itself to the player, and make a meaningful experience for those of varying skill levels.

During the course of the game, the player is asked to monitor an array of changing elements: the time clock, the puck on the right of the screen, the continually stacking icons on the play area, and the combinations of icons forming on the screen. The game speeds up and creates a more challenging experience when the player begins to gain a lead on the computer. In contrast, if the player is having a difficult time scoring, the game will slow down to provide a greater scoring chance. For a player who might be a slower learner, this provides an opportunity to master the mechanics of gameplay.

On the left of the screen is the “No Stack Zone”. This area, 2 grid-spaces wide, responds differently than the area to the right that is 4 grid-spaces wide. Pieces that land in this area are instantly removed from play. This balance mechanism provides the player with greater choice while setting up combinations, and forces the player to choose which pieces to keep in play and which ones to sacrifice. This area can also be used to discard dangerous icons such as the bomb icon. Because of this unique area, the game balance is manageable but in constant flux, and this results in more interesting gameplay.

3.1.3 Uncertainty

Though the gameplay in *Symptom Shock* is somewhat similar to that of *Tetris*, it takes on a different approach with uncertainty (Salen & Zimmerman, 2004). In *Tetris*, the end state is reasonably certain - the player will lose every time unless the final level is reached and completed. Despite the odds against them, players return to the game, uncertain of what their score will be the next time they play. In *Symptom Shock*, however, the final end-state is less certain. The player cannot predict what the score will be, whether or not they will win, or whether the game will end in a frantic overtime period. The only thing certain is that the game will end in a win, loss, or tie after approximately three minutes of gameplay.

If the game were entirely uncertain throughout its duration, it would be very difficult for the player to establish any sense of meaning from the experience. It is important that the player is able to reduce the level of uncertainty through and integrated series of gameplay actions. *Symptom Shock* allows this to occur because it provides the player with opportunities to set up specific combinations that, if carefully planned and executed, can significantly influence the outcome of the game. Through all the uncertainty, the player's integrated choices to build combinations and add to his or her team's score creates a sense of meaning and control within the experience.

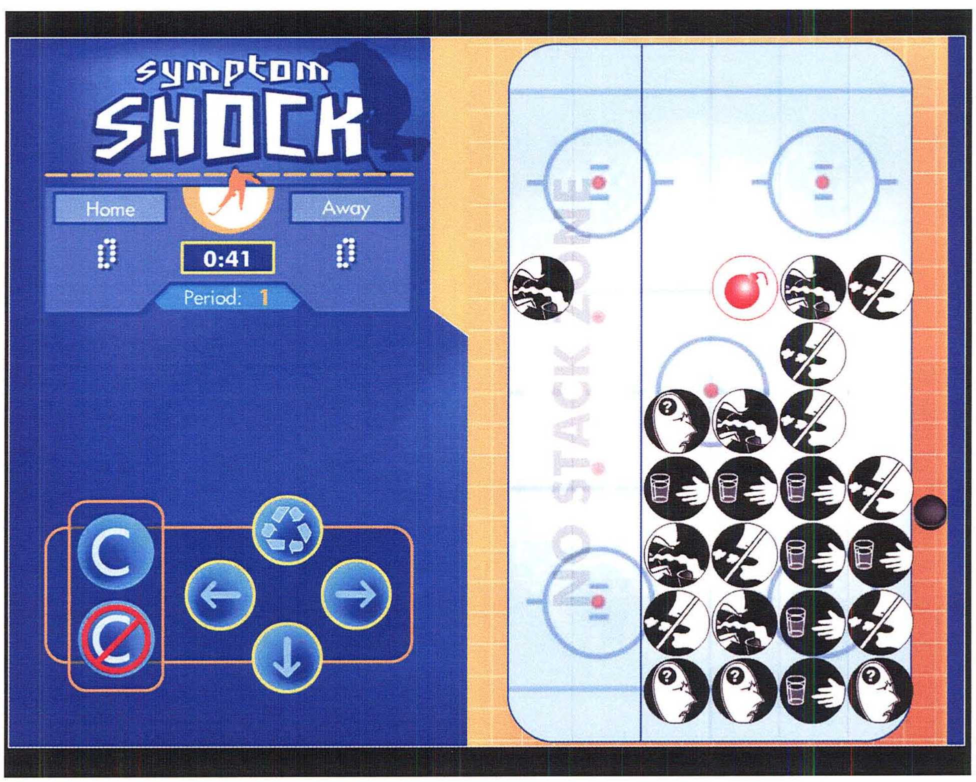
3.2 Learning with *Symptom Shock*

3.2.1 Explicit vs. Implicit

Educational videogames have too often fallen into the trap of becoming merely motivated learning tools. Recognizing the motivational power of videogames, educators have tried to capitalize on this and use games as a 'sugar-coating' for the actual learning experience (Reiber, 1996). In these types of games, the learning is explicit. In the classic edutainment title *Math Blaster* (Davidson & Assoc., Knowledge Adventure Inc., 1994), the gameplay and the space-like environment do not have a natural or direct relationship to the math questions that appear on the screen. While it may be fun to target a spaceship reticule on junk flying through space, the learning - which involves memorizing math equations – is explicit and obvious to the player. When the target audience becomes aware it is being coerced into learning, they may feel patronized by the game experience (Kirriemuir & McFarlane, 2004).

It can be advantageous to embed learning within the play experience. Gameplay that is enhanced, rather than distracted, by educational content is less likely to make the player feel coerced into learning. In *Symptom Shock*, the identification of symptom icons is essential to winning the game. Once groups of icons have been put into place, the player must identify whether the symptoms are concussion related or non-related (Figure 3.2). The learning that takes place in *Symptom Shock* is explicit to the player because the symptom icons and process of identifying them has little to do with the hockey environment that they are situated in. The concussion learning content could very easily be replaced with other content.

Figure 3.2: Screenshot of *Symptom Shock* gameplay



Screen capture, *Symptom Shock* (© David Goodman and Brad Paras, 2004, by permission).

3.3 Results

3.3.1 Pilot Study

Three studies were conducted with *Symptom Shock.* The first, a pilot study, aimed at determining the usability of *Symptom Shock* and examining the effect of game content on concussion knowledge. The structure of the experiment had the participants (23 youth hockey players) sit down at a computer, view some instruction, play two complete games, and respond to a 36-question questionnaire on concussion symptoms. Two groups participated: 1) an experimental group that was subjected to concussion icons and 2) a control group that was subjected to shapes & dice icons.

3.3.1.1 Results

Overall, participants appeared to understand how to play *Symptom Shock.* By the second game, the number of games won was almost equal to those lost (9 wins, 10 losses, 4 ties). Since our testing playtime window was limited to 20 minutes, we wanted to ensure that the game could be learned within such a short time span. Post-game conversation with participants indicated that the game was fun to play. Examination of test scores showed few differences across the control and experimental group. The scores were quite high across both groups, and this was accredited to a ceiling effect (both groups entered the experiment with a strong understand of educational material). The experimental group, however, finished the test 30% quicker on average. These results founded our next experiment, Study 1, which was designed to determine whether game content was having an effect on knowledge acquisition.

3.3.2 Study 1

A few minor adjustments were made for Study 1. During the pilot study, we did not have a quantifiable method of determining the quality of the game. A feedback questionnaire was added subsequent to the concussion symptoms questionnaire. Participants were asked questions about their concussion history, videogames, and hockey experience. In addition, participants were asked to rate the game's difficulty, instruction, quality, and level of enjoyment. One hundred thirty minor hockey players participated in the study, randomly organized into the same grouping as the Pilot Study.

3.3.2.1 Results

In contrast to the Pilot Study, the results from Study 1 suggested that exposure to concussion content via the computer game improved identification of concussion symptoms. In line with the Pilot study, the results from Study 1 suggested that exposure to concussion content via the computer game can increase the speed of recognizing concussion symptoms (Goodman, Bradley, Paras, Williamson, & Bizzocchi, 2006).

Early versions of *Symptom Shock* utilized a 'Text and Image' teaching approach to instruct players how to play. Plays were able to access a series of instructional pages that provided text with corresponding images to explain the rules of the game. Initial user tests indicated that the static information obtained while reading this instruction did not transfer well into the gameplay.

To better teach the participants how to play *Symptom Shock*, participants from the Pilot Study and Study 1 were presented a video demonstration of the gameplay. This video with voiceover demonstration provided a clear demonstration of the rules and strategies for winning. Since this approach was used in both studies, results of the game usability were similar – most participants successfully made combinations, but not all resulted in goals. The results from the feedback questionnaire indicated that the game difficulty was appropriate and that the gameplay was not frustrating. However, only half to three-quarters found the instructions easy to understand (Goodman, Bradley, Paras, Williamson, & Bizzocchi, 2006).

While observing the participants, we noticed that during the video demonstration, some participants were unable to maintain focus. The instructional video must be viewed prior to playing the game. With this in mind, we designed the video to be concise so that the players were not held back from playing the game. Due to the complexity of the game and the rules that must be learned, the final video length was about three minutes. We attributed the participants' loss of focus to two possible causes: 1) video length – player is anxious to play and cannot be bothered to sit back and view a video and 2) video pacing – the demonstration is too rapid and the concepts cannot be learned within the time span allowed. With these problems identified, the game instructions were altered and assessed in Study 2.

3.3.3 Study 2

The significant change made for Study 2 involved a modification of the pre-game instructions. Understanding how to play *Symptom Shock* is an important step in the educational process. If a player becomes frustrated with moving the icons and understanding how to score, he/she will have a more difficult time getting to the point of identifying combinations of concussion symptom icons – the point at which learning occurs. In Study 2, the video with voiceover instruction was replaced with an interactive tutorial with audio overlay. The interactive tutorial addressed the two issues described above by allowing the player to interact with the game at his/her own pace.

The interactive tutorial re-creates the experience of *Symptom Shock* by placing the player in what appears to be an actual game. The action on the screen is identical to what a player would see if he/she were actually playing. At key points during the game where the player would normally be required to interact, the game pauses, explains what action to take, and then waits until the player proceeds. This situated approach to instruction makes for a manageable learning experience of skills that transfer directly to the actual game. Thirty-nine minor hockey players participated in the study.

3.3.3.1 Results

The results with respect to increase in concussion knowledge were very similar to those shown in Study 1, with participants of the experimental group scoring higher in the concussion questionnaire and doing so in less time. In Study 2, however, participants appeared to understand gameplay considerably better than in the previous two studies. Of the seven participants who scored no goals, no participants made zero combinations. When considered with respect to the bantam group in Study 1, these participants won more, lost less, tied less, and a greater proportion scored at least one goal (Goodman, Bradley, Paras, Williamson, & Bizzocchi, 2006).

The feedback questionnaire that followed the game also showed an improvement in gameplay understanding. Compared to Study 1, fewer participants agreed that *Symptom Shock* was difficult to play, and more disagreed. More participants agreed that the instructions were easy to understand and although responses regarding frustration changed little, more participants in Study 2 very strongly disagreed with the statement that the game was frustrating to play. These responses seem to indicate that the interactive tutorial approach to pre-game training had a positive impact on game experience by better equipping the players with the knowledge necessary to play well and have fun.

3.4 A New Problem: Learning to Play

Over the course of this research, the importance of learning how to play became clear to us as we observed how it affected both the experience of play and the outcome of the learning experience. The teaching approaches that were taken with *Symptom Shock* seemed to result in an improvement in game play, however it was not clear whether application of similar approaches to other games would yield the same effects. Though the changes made to the instructions were inspired by two distinct negative effects of the video with voiceover approach, no prior research - other than personal experience – had influenced our decision to create an interactive tutorial. The videogame industry includes thousands of games, each one having faced the same questions we did.

A look into industry practices and trends could provide us with knowledge on this important aspect of game creation.

3.4.1 Games & Situated Learning

One of the significant findings we discovered from this research is the ability for games to record the effectiveness of situated learning qualitatively. If the learning of a game takes place within the actual game environment, it can be described as 'situated learning', as opposed to the video with voiceover training, which placed learning outside of the actual game environment. Since the game is tracking the player's actions, it can determine performance within the situated environment. As opposed to many of the tasks that benefit from situated learning, there is no subjective interpretation of the learner's performance.

During our studies with *Symptom Shock*, we looked at the performance impact of different training methods, but did not look very closely at reasons why the modifications had improved performance. The context in which learning takes place is an integral part of what is learned (Brown, Collins, & Duguid, 1989). In the same way that learning vocabulary requires contextual information such as a surrounding sentence, learning to play a game requires the complete experience. The original instructions for *Symptom Shock* used text and images to describe the abstract rules of the game. Switching to a video with voiceover approach provided some context for these ideas. It enabled the player to understand the environment in which the icons were placed and how they moved in relationship to time and space. Missing from that context, however, was the role of user interaction. By placing the player into a mock gameplay situation and enabling them to interact with the game and see how their interactions affect the systems within the game, they were able to take in a greater understanding of the overall context. It could be for these reasons that those who learned with the interactive tutorial performed better than the participants whose learning took place outside of the game situation.

3.4.2 Post-Mortem

The initial findings discovered during the *Symptom Shock* studies were exciting and provided a first-look at the influence of varying approaches to game training. However, the studies were focused on determining whether videogames can convey educational material in an appealing manner. Our efforts to make the gameplay easier to learn were incidental to the original project, but did point to an important are for subsequent research. This new domain of enquiry became the basis for this thesis project.

4 FINDING A SOLUTION TO THE PROBLEM

The challenge of teaching players how to play videogames is an issue that game developers have always had to address. Game developers have tackled this problem in a variety of ways. Over time, new approaches have been adopted and utilized across different gaming genres. Upon completion of our studies with *Symptom Shock*, we realized that there might have been other approaches we could have implemented to help players learn the game.

With a second game in development, I took it upon myself to investigate this problem more thoroughly. I developed a database that classified and compared the in-game training strategies of nearly 50 videogames from a variety of platforms and genres. With this amount of information, I was able to formalize a framework that effectively describes the training strategies provided within any videogame. This framework was useful when we began to establish the foundation for the training approach taken within the second educational hockey game we were developing.

4.1 The Database

4.1.1 Purpose and Function

The purpose of the games database was to collect both quantitative and qualitative information about a variety of games. The focus of the information that was collected was on the training that took place within the game. By breaking down the in-game training of each game, I was able to develop profiles that spoke to the depth and type of training of the games. It quickly became clear which games had put a greater effort into teaching the player how to play.

To collect the data, each game was played for 30-60 minutes, or until the training portion of the game had completed. During the play period, the in-game training techniques were observed and noted (see Appendix C). Screenshots were captured to provide visual reference. Subsequent to play, a brief paragraph was written about each game that described the training that took place.

4.1.2 Recorded Data

I captured a variety of information about each game into fields, with each falling into one of four categories. *Game Data* provides specific information about the game tested. *General Training Information* provides a basic picture of the game's difficulty and the time it takes to learn the necessary skills. *Training Features* are the specific features embedded within the game that either exist or do not exist. *Comments* are general descriptions of the training experience.

4.1.2.1 Game Data

- Game Name: The name of the game as indicated on the packaging.
- Developer: The developer of the game as specified by www.ign.com.
- Publisher: The publisher of the game as specified by www.ign.com.
- Year Released: The year in which the game was released for sale as specified by *www.ign.com*.

- Genre: The genre of games within which the game sits as specified by *www.ign.com*.
- Platform: The platform on which the game was played.
- Players: Whether or not the game supports single player and/or multiplayer functionality.
- Rating: A rating out of 100 as specified by *www.gamerankings.com*, a website that combines ratings given by editors/reviewers from print and online media.
- Hardware Interface: The interface by which the game was played.

4.1.2.2 General Training Information

- Training Time: The time, in minutes, that it took to complete the in-game training.
- Learning Curve: The time, in hours, to learn the game as specified by www.gamespot.com.
- Difficulty: The difficulty of the game as specified by www.gamespot.com.
- Learning Content: The focus of the in-game training (i.e. interface mastery vs. strategy).

4.1.2.3 Training Features

- Print: A printed manual.

- On-screen Text: The use of text to portray training information.
- Help Avatar: A character displayed on the screen whose primary purpose is to teach the player how to play.
- Video: A video demonstration of gameplay techniques.
- Voice-over: The use of voice-over to explain gameplay techniques.
- Context-sensitive: Training that arrives at a moment when it is most needed.
- Controller Diagram: A visual representation of the input device that explains its use.

4.1.3 The Games

The majority of the games that I selected for inclusion in the database originated from my own personal collection. These games vary in platform and genre, but do tend to be games with higher than average ratings. There are 49 games within the database. Of these games, the genres played were Sports (37%), Action (24%), Driving (12%), Adventure (4%), Music (4%), Simulation (4%), Platformer (4%), RPG (4%), Puzzle (4%), and Strategy (2%). The Sports games and RPG games had the lowest average number of training features per game. The emphasis was on sports since this information was collected with the intention of applying it to a hockey game. Of the eighteen sports titles, twelve were hockey games.

The average *gamesraking.com* score of the games tested was 82%. This number is high due to the quality of the games reviewed, and would have been higher if some of the hockey titles were not included in the database. Within the sample of games tested, those of higher ratings generally included more training features. On average, games scoring 90% and above utilized 2.93 features while games below 90% utilized only 2.57 features. The use of higher rated games allowed us to collect in-game training data from a richer source of examples.

The selected games also vary in age. New game designs have also become much more complex. Due to this, in-game training becomes even more important. Though most of the games that were included in the database are new, some older games from the *Super Nintendo Entertainment System* were also included. The final breakdown includes 11 from 2004-2005, 15 from 2002-2003, 13 from 2000-2001, and 10 from 1990-2000. As expected, the newer games generally included more training features.

4.2 Learning How to Play the Games in the Database

The process of defining the training features was an iterative process. As I looked at new games, additional training features were revealed. These were added to the database. Although many games utilized in-game training similar to training features indicated in the database, there were also slight differences within each feature. It wasn't until after the entire process was complete that I was able to form a complete framework with which to describe in-game training.

Two dimensions make up in-game training. First, one must consider the *type of training* they would like to use. This includes the various training elements that make up the instructional process. Information can be portrayed a number of different ways, such as by use of text, pictures, or video. Each of these has specific advantages or disadvantages.

The second dimension to consider is the *time and space of learning*. The point at which learning occurs can have a significant impact on the usefulness of the training. As illustrated in the *Symptom Shock* study, the length of the training can also hinder the training. If training gets in the way of play, it can cause the player/learner to lose focus and miss important information. If the training is relative to the current state of play, there is a positive impact on learning because the time and space of the learning can influence the significance of the training to the player at any given time.

4.3 Types of Training / Training Elements

4.3.1 On-Screen Text

A common training technique is the use of on-screen text. Text offers a number of advantages. Most often, text is presented in such a way that the learner can absorb the information at his/her own pace. If information is confusing, the learner can re-read until the concepts are understood. From an economical standpoint, text is affordable since it can very easily be localized for different regions. Text is also very easy to produce. The majority of the work lies in responsible writing so that the learner is not easily confused.

Often the use of on-screen text is accompanied by symbols that relate to the instruction presented. These symbols relate to elements of the instruction that do not change regardless of language, such as controller icon graphics. Rather than saying, "Press the circle button to jump." an image of the circle button would be used in place of words. Since "the circle button" is merely a sign to describe the actual button, a picture is used to get to the point and avoid confusion. The mix of text and image is common and is described in the following training type.

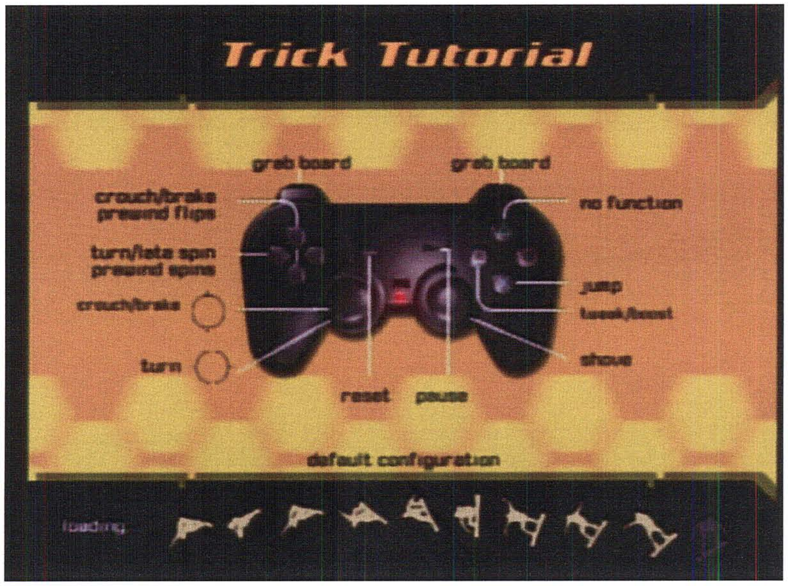
Videogames are often very visually oriented. In most games, players must analyze the visual action on the screen and make decisions accordingly. Because of this, the use of text can be problematic in certain circumstances. If shown outside of gameplay, this is not an issue; however, to instruct a player by this means during gameplay, the text must be placed on the screen in a location that does not interfere with the game. For this reason, games will often place text in the upper left-hand corner or other locations on the screen that do not interfere.

4.3.2 Pictures / Images

With respect to in-game training, a picture is really worth a thousand words. Images give the learner a visual reference point for the learning. Text, when presented alone, can be very difficult to translate into a game since the player must form mental images in his/her head. These images will never match perfectly to the training described. The use of images eliminates this point of translation. Pictures, however, have a difficult time focusing the learner's attention. If the learner does not know which part of the picture will enhance their ability to play, the picture can become almost useless. For this reason, pictures are often presented with text that describes the visual representation.

Games use images to teach different aspects of gameplay. By far, the most frequently used visual aid is an image of the control interface. Rather than having to read a lengthy text to learn how the game is controlled, a single image allows the player to determine quickly which part of the image portrays the information that they need. Controller diagrams appear in four primary locations: in loading screens, option menus, tutorials, or video demonstrations (Figure 4.1). Since tutorials often focus on one skill at a time, the controller diagrams highlight the buttons necessary. In contrast, loading screens and option menus often show all the information in one screen, depending on the complexity of the controls. Some games have different control setups that are contextually related. For example, the buttons in *NHL 2005* (Electronic Arts, Electronic Arts, 2004) react differently while on defence than on offence. In games that are more complex, there is often a 'function' button that when depressed, causes all buttons perform new, less basic actions.

Figure 4.1: Controller diagram image (loading screen)



Screen capture, *SSX Tricky* (© Electronic Arts, 2001, by permission).

Images are also used to explain concepts in ways that text cannot. For example, in *Katamari Damacy* (Namco, Namco, 2004), images coincide with textual explanations of game concepts to provide a clearer presentation of the concepts being described. In the example of *Katamari Damacy*, images are shown sequentially, almost like video, to provide a closer representation of reality. Images are often also interesting to look at and can improve the readability of the training, increasing the interest-level in the learner.

Gameplay examples and diagrams are also used to visually show the interaction that takes place during gameplay. Often a simple image can make a complex relationship easy to understand. For most players, visual diagrams are easier to remember and this could increase the chance of the learning being applied in game.

4.3.3 Voice-over

Another common technique used for in-game training is voice-over. Since games are visually very complex and often require constant monitoring of the action-taking place on the screen, any extra visual information could either become overwhelming or distract the player. For this reason, it is difficult for a player to read text and continue playing a game at the same time. By utilizing a different sensory channel such as hearing, two streams of information can be provided at the same time and this has the opportunity to enhance the learning experience by providing richer information.

Voice-over effectively removes text. During segments of voice-over, the player can continue playing the game and use any new information to improve their approach. If the voice-over content is directly related to the content shown on-screen, the understanding enhance, however, if voice-over information conflicts with visual input, the learner has to choose which stream to focus on and inevitably cannot gain as much information.

There are two primary limitations to voice-over. First, since voice-over is time based and cannot be slowed down, the rate of learning is constant. Slow learners can fall behind while they try to process the information, create a mental model, and turn it into something that makes sense to them. Fast learners can easily become bored if the voice-over is too slow. Voice-over is also limited since it is very subject to false interpretation. Accents and linguistic style can interfere with the learner's interpretation of what is being said. Therefore, it is important that localization is done carefully and this can become costly since professional voice talent must be found for each language used.

4.3.4 Video Demonstration

In most videogames, time plays an important role. How things move greatly affects their relationship with the environment. In contrast to board games, where gameplay is merely a transition of different board states, physics (realistic or not) are very important in video games. Since physics are best observed over time, the use of mere images does not provide the leaner with a complete understanding of the interactions that take place during play.

Another common training feature in videogames is the use of video demonstration. Usually, video is accompanied by voice-over, images, and/or text. Video is able to replicate entirely what is shown on screen and thereby provide a closer representation of what the player will see and experience during the game. When used to teach videogames, video demonstration focuses on key aspects of the gameplay and uses voice-over, text, or graphics to focus the learning. Often, controller graphics will animate in accordance to the action in the video.

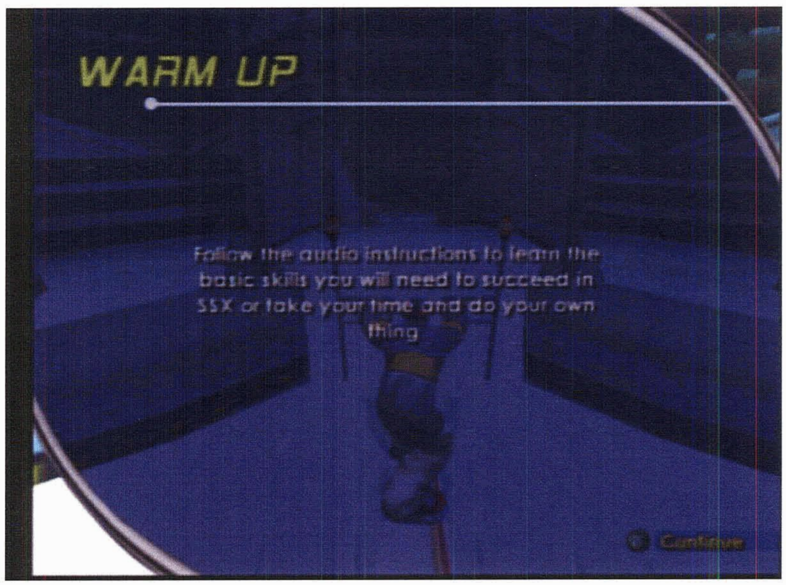
Video does not always perfectly replicate what the player will see in game. Generally, there are three levels of representation that can be used: 1) actual game perspective 2) in-game alternate angle 3) alternate source. Most video demonstrations use the actual game perspective to explain gameplay concepts. This approach eliminates any loss in translation. A common approach among sports games is to use in-game video but from alternate camera angles. For example, in *NBA Live 2004* (Electronic Arts, Electronic Arts, 2003), video is used to explain how to shoot and pass, but rather than show examples from the distant camera angle that is used during play, the video presents the play from on-the-floor camera angles that make the video more appealing to look at. The third level of representation is by far the least used and involves using video from a completely different source to provide context and reason for doing the action. An example would be the use of actual NBA basketball footage of the equivalent shooting and passing actions available in the game. By doing so, players are able to understand the context that the actions originate from, which may also increase their interest and understanding.

In the same way that voice-over is limited, video cannot be slowed down and risks losing slower learners. Of all the games observed that included video demonstration, not one included any sort of playback control. If there were concepts taught that were at all confusing or difficult to understand, the games required the player to either watch the entire video again or simply miss the instruction. Simple pause and rewind controls would have made the learning experience more meaningful; however, this could increase the learning curve since these controls would also have to be learnt.

4.3.5 Interaction

Taking representation one-step further, many newer games make interaction a part of the learning experience. Since interaction is a key part of the gameplay, it only makes sense that this be enabled during the point at which learning takes place. In the same way that video provides context by showing how things change over time, interaction also provides deeper learning by allowing the player to physically perform the necessary actions rather than simulate them in his/her head.

Figure 4.2: Interactive tutorial



Screen capture, *SSX* (© Electronic Arts, 2000, by permission)

Interaction has been used in videogame training in a number of different ways. A common approach is to first explain a concept or action via voiceover, text or video, and then offer the player an opportunity to attempt the action (Figure 4.2). In a music game by Harmonix called *Amplitude* (Harmonix, SCEA, 2003), a voice first explains how to blast notes, and then allows the player the opportunity to try. Once the player successfully completes the action, the tutorial carries onto other concepts. By the time the tutorial has concluded, the player has interacted with the game in the same way that they will when playing the real game. By allowing the player to interact with the game, they are able to get a feel for the gameplay and this enhances the learning experience. In fact, by introducing interaction, the learning experience becomes situated, which increases the learner's ability to transfer the knowledge to the real gameplay experience.

4.3.6 Mentor Avatar

Learning is often conceived as transfer of knowledge. Though we learn many things through our own mistakes, the more efficient way of learning is by gaining knowledge from an expert source. Some games use this approach to learning, having a mentor avatar or character who teaches the player how to play. In essence, such devise is similar to voice-over; however, avatars provide a personality and face to the instructor. This way, whenever the player sees the avatar, he/she knows to focus on what it has to say. In videogames, avatars tend to popup onto the screen during times of learning. After delivering the message, the avatar fades away. Once all training is complete, the avatar does not return unless called upon by the player for more information.

4.4 Time and Space of Learning

Perhaps equally as important as the type of training used, one must consider the time and space of learning. In the games observed, the features above appeared at different points in the gameplay experience. The time and space of learning is important because it influences the player's ability to apply learning, it can affect the player's ability to enter a state of flow, and it can potentially have a negative effect on the magic circle surrounding the gameplay experience. Learning occurs in videogames at three primary time/spaces.

Learning can occur before-play, in a subset of play, or in-play. These are important to understand and each has specific variations to consider.

4.4.1 Before-Play

Before-play training includes any training that takes place before the gameplay experience begins. By far, the most common form of training that takes place before play is via instructional manuals. All console manufacturers (Sony, Nintendo, and Microsoft) require that printed instructional manuals are included with any game published. In the past, these manuals were very thick and taught nearly aspect of the gameplay. However, it is now the opinion of publishers that manuals are expensive to print and that players rarely read them. Therefore, most manuals are now ten pages or less, limiting instruction to disc handling and very basic control overviews.

Instead of spending money on printed materials, developers have moved their instruction onto the disc. Not only is this approach more cost-effective, it also allows for more additional training approaches such as video demonstration. For instance, in *NHL 2K5* (Kush Games, Sega, 2004) and *NHL 2005* (Electronic Arts, Electronic Arts, 2004), players can use the in-game menu system to access training videos. By viewing these videos prior to playing the game, the player is able to learn the basics of the game. Among the games observed for the database, most of the before game in-game training was in the form of video demonstration. However, in *NHL 2K5*, a complete manual is also available via the menu system. This manual is over 200 pages long and looks like an actual textbook.

Another common approach to before game training is to present instructional material while the game loads. Loading screens provide the perfect training opportunity before the game since the player must wait anyway. When presented as loading screens, the training is appealing since it reduces the boredom that might occur otherwise. Controller diagrams are often presented during loading screens. For beginners and experienced players alike, a quick look at the layout of the controller can inform players about how to best interact with the game. Loading screens are also used to present random tips and strategies, usually in the form of text and images.

4.4.2 Subset of Play

Moving closer to the true gameplay experience, tutorials enable the player to learn in a subset of the play experience – an environment that resembles the full game environment, but has reduced user interaction possibilities. Tutorials are intriguing because they tend to become games in and of themselves. While not technically a part of the full game experience, tutorials require that specific goals are achieved and end states are reached. With respect to learning, tutorials are advantageous because they focus the learning by keying in on certain aspects of play at a time. In contrast to before play learning where the player must learn a large quantity of information and decide for him/herself how and when to apply it, tutorials teach one or two ideas and provide the player with an opportunity to put them into action.

Tutorials can be either restricted or unrestricted. Restricted tutorials do not resemble the actual gameplay experience because they limit player action to a much greater degree than in the complete game. For example, in *Frequency* (Harmonix, SCEA, 2002), the in-game tutorial focuses on one action at a time. Before moving onto new ideas and actions, the player must successfully complete the current action. All other actions are disabled and therefore the experience is limited and incomplete.

Unrestricted tutorials act more like guides. In these tutorials, players receive instruction and are presented a scenario within which they can apply what they have learnt. What the players does, however, is not limited. If the player is taught how to jump, he/she can still perform all other actions possible by the character. It can be more difficult to ensure that a player is actually learning the skills taught in an unrestricted tutorial, though checks can be put in place to monitor the player's actions. While restricted tutorials tend to equal in duration, unrestricted tutorials are more variable depending on the player's abilities and choices.

Some games provide very basic subsets of play for the primary purpose of learning. Practice modes are not uncommon in videogames, especially among music games and sports games. In *NBA Live 2004*, players can access a 'Practice Mode' within which they can practice game skills such as shooting, dribbling, and dunking (Figure 4.3). Since there are no goals or objectives in this game mode, it can quickly become boring. However, for dedicated players who want to improve their game, practice mode provides an opportunity to play around and improve skills.

Figure 4.3: Practice training in a subset of the full play experience

Screen capture, *NBA Live 2004* (© Electronic Arts, 2003, by permission).

4.4.3 In-Play

One of the disadvantages of both before-play and subset of play training is that they both stand in the way of the true gameplay experience. When a player sits down to play a game, they often cannot be bothered with reading manuals or making their way through tutorials. However, it is the experience of learning and improving skills that makes games so fun. To get players in a state of flow, they must continually be challenged. Challenge exists when difficulties are presented and the player must learn strategies and skills that enable them to surpass the challenge.

To ensure that players get the training they need, training is often embedded within play. As games get more and more complex, the amount of training necessary to understand fully how to play a game would severely impede the player from entering into the game. With lengthy games, before-game training is less effective because by the time the player needs to apply the skills, they may have already forgotten what was learnt. Games now use a teaching approach that provides the learner with information prior to an event where that information is needed. In *Need for Speed Underground 2* (Electronic Arts, Electronic Arts, 2004), players roam around a living city, searching for different racing events to compete in. If the player comes upon an event that they have not yet participated in, a video demonstration is shown that highlights the rules of the race and how to best compete. This timely placement of instruction provides the learner with the information when it is most needed.

While the example of in-play instruction explained above exists within the game world, it still exists outside the true play experience. Rather than present information before a new event, some games present the information during the event. This context-sensitive information is directly related to what the player is doing at any given moment. In *Grand Theft Auto 3* (DMA Design, Rockstar Games, 2001), the player receives small bits of instruction in the upper left hand of the screen whenever he/she needs to perform a new action. The first time he/she walks up to a car, some text explains how to open the door and so forth. In *GTA3*, the instruction is non-invasive since it appears away from the action on the screen and does not pause the game. In some games, it is imperative that the instruction be read in its entirety so that the player has time to digest the information without worrying about things happening in the game. This invasive form of context-sensitive training pauses the game and places the instructional information at the forefront.

Not all instruction that occurs during play happens before the event. Some games observe player action and provide instruction accordingly. Rather than assume that the player lacks the knowledge necessary to perform an action, these games wait until a player has failed a few times before providing any instruction. Training that occurs during play is useful because it solves a number of issues related to learning how to play. Translation is not an issue since it more often than not is presented in a way that resembles the actual experience. Memory loss is not an issue since there is no time delay between when the learning takes place and when it is applied. Moreover, the learning is desired by the player since it will ultimately help the player perform better in the conflict they are presently battling.

4.5 A Training Strategy for a 3-on-3 Hockey Videogame

With a more complete understanding of in-game training and the possibilities available, we set out to develop a training strategy for *Heads Up Hockey*, a 3-on-3 hockey game that also focused on teaching young hockey players about concussion (Ciavarro, Meanley, Bizzocchi, & Goodman, 2005). The primary goal was to teach the players in such a way that the learning of the game itself would not get in the way of learning the educational content – a problem we had experienced in the past. To maximize overall learning, we wanted an efficient training approach that did not interfere with the game and the educational content within it.

4.5.1 Characteristics of Hockey Videogames

Like many sports games, hockey videogames are predominately controlled while using a camera that is zoomed out to enable wide coverage of the field of play. This enables multiple players to be seen at once. During gameplay, the player can control any of the skaters on the ice by simply pressing a button to cycle between them. Since hockey videogames are modeled off their real-life counterparts, gameplay is non-linear. The contest is on-going, with no level to traverse and ascend. The narrative arc of each game cannot be predetermined since the gameplay is emergent – the result of complex and unpredictable series of interactions. Each game of hockey is a unique story in and of itself.

Hockey is a very fast sport. Hockey videogames reflect this and most often include very fact-action gameplay. When you consider the speed and the unpredictability of the game, it would appear that any training would have to occur before play since proper timing of context sensitive training would be difficult, and since the game is so quick, there would be no time to learn. In all of the hockey games inspected for the games database, not one included any form of context-sensitive training. The closest example of this was in *NHK 2K5's* (Kush Games, Sega, 2004) skill competition where brief instruction was provided before each event. Even then, these mini-games are different from hockey itself and since each event is a new game, the training is before-play.

4.5.2 Types of Training

For *Heads Up Hockey*, we used two of the training features described above. We based our selections primarily on resource cost – factoring in the time needed to produce the assets for the feature. We used *text* to explain gameplay features. Features such as checking, shooting, and skating were explained in detail. To emphasize key words and ideas in the text, we bolded some words.

The second feature that we used was pictures. Prior to playing the game, players were presented with a controller diagram that explained the function of each button on the controller. In addition, along with almost all of the text instruction provided, animated controller diagrams illustrated how to use the controller to perform the action described. Pictures of the in-game characters performing the moves were also used to bring context to the words. For each game feature explained, two images, an animated controller diagram, and a couple sentences of sentences were used.

4.5.3 Time of Learning

While researching videogames for the games database, it became clear to us that in-play training was ideal for a number of reasons. It meant that the player could jump right into the game and waste little time. It also meant that the learning could be context-sensitive, providing a more meaningful learning experience. For *Heads Up Hockey* we considered this concept and began thinking about how we could apply this approach to a hockey game where the need for particular skills - and therefore skills development - was unpredictable.

The first strategy considered, was to start the player in a training camp where they would learn the skills one at a time with instruction provided along the way. This idea proved to be too difficult to implement so we had to re-consider our approach.

Since videogames are procedural in nature, it is not difficult to place checks in the code that observe the state of the game is at any time. To provide a context-sensitive learning experience for *Heads Up Hockey*, we adopted the *after failure* approach wherein we evaluated the current situation and determined if and why the player was failing to perform. For example, if the player skates in the offensive zone for a certain duration of time, we assume they do not know how to shoot. Since *Heads Up Hockey* is real-time where speed is essential, the training cannot occur during play. Therefore, the training is invasive; it pauses the game and shifts the focus until the player has finished reading the information.

These are the training approaches chosen for *Heads Up Hockey*. Some of the features used are not unlike those used in other hockey games, however the time when learning takes place is very different from in all other hockey videogames. The next chapter explains the ways in which this training system interacts with player playing the game and in it, I compare and contrast a before-play training approach with the aforementioned in-play approach.

5 TESTING THE SOLUTION: *HEADS UP HOCKEY*

Under the auspice of a CIHR funded grant, a team of programmers and artists at Simon Fraser University created a 3-on-3 hockey game called *Heads Up Hockey*, which uses both cut-scenes and gameplay mechanics to teach young hockey players about concussion. Employing a top-down perspective, the game allows the player to control multiple in-game characters and make coaching decisions such as editing and changing lines.

During initial testing, it became evident that there were factors that were inhibiting the game's ability to teach. Despite the developers' abilities to succeed in the game quite easily, participants in the study had a very difficult time mastering the controls and game mechanics. We noticed that the process of learning how to play the game was interfering with the educational goals of the software. Players first had to learn how to play the game and perform in-game controls automatically before they could fully engage with the educational content.

During pilot tests, *Heads Up Hockey* used a graphic to display the controller configuration and some textual hints to teach the player how to play. We assumed that the participant would use this information to play; however, whether the participant actually read the content was unknown. Since the effectiveness of educational games rely on their ability to teach and provide an engaging experience for the player, *Heads Up Hockey* needed a way for players to learn the controls and game mechanics more quickly.

Building from knowledge that was learned in earlier studies with *Symptom Shock*, alternate training methods were developed. These included before game text and image, before game video and voiceover, and context sensitive in-game text and image. During the experimental planning stage, it was determined that the primary area of interest was in the difference between before-play training and in-play training. Thus, only three conditions for the study were used: 1.) Control 2.) Before-play text and image, and 3.) Context-sensitive in-play text and image.

5.1 Background: The Educational Setting and the Game

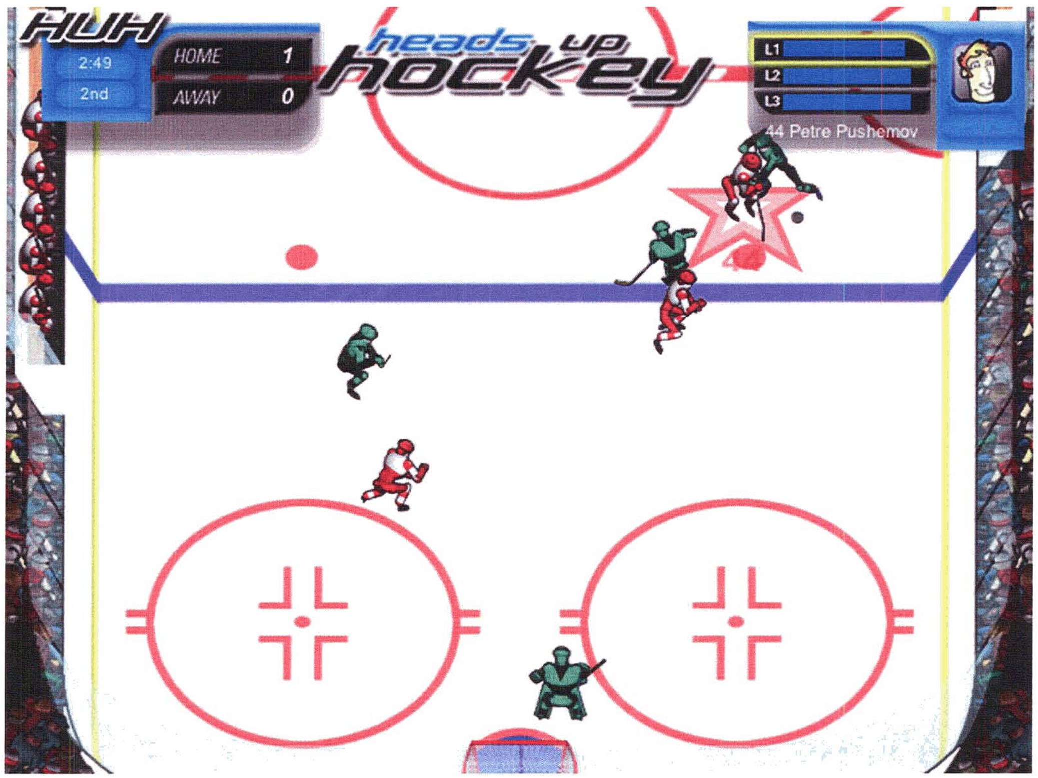
Perhaps the most prominent form of game throughout history has been athletic sports, both individual and team-based. These virtual battlegrounds provide players with an opportunity to fulfil a particular role and engage in an artificial battle with no real consequences -- other than bruises and pay-cuts, of course. It is no real surprise that most of the first 'video' games were simply digital replications of these games. With the advent of video games, players could control an entire hockey, football, or baseball team and play against other human opponents or even an artificial, CPU-controlled team.

Though many other interesting videogames were created (including the original *Space War*), players found a unique interest in more practically engaging with the strategic aspect of sports without having to be a coach. Videogames allow a player to fulfil a number of different roles. In these positions, a player can gain a more holistic view of the game and the variety of interactions that take place. Over the years, we have seen sports games go from very simple abstractions (i.e. *Pong* demonstrates the core gameplay of hockey – hitting a puck into an opponent's goal) to very complex simulations that give the player control over many aspects of the game (i.e. *NHL 2K5* enables the player to assume the role of a manager, giving them the opportunity to make trades and setup training schedules, as well as control individual players on the ice).

In the spring of 2003, a team of programmers and artists were put together to produce a hockey game that would teach young hockey players about head concussion. During the design phase of the project, it was decided that the game, called *Heads Up Hockey*, would be a three-on-three hockey game, stylized from the console hockey games of the '90s (Figure 5.1). These hockey games were presented in a ¾ view with play occurring top to bottom. The graphics derived from a series of animated sprites and the play was often quick and furious. The controls in these games were often limited to just a few buttons, allowing anyone to easily pick up a controller and begin playing.

Heads Up Hockey was created using the *Macromedia Shockwave* platform. The in-game characters are 3D sprite renderings modelled in *3D Studio Max* at 30 frames per second. Background layer sprites such as the ice rink and HUD were created using *Adobe Photoshop.* The game was coded from the ground-up using *Lingo* script. *Macromedia Flash* ".swf" files were used for the game menus and the in-game cut-scenes. When all these elements work together, they form a hybrid game that has elements that are visually similar to modern hockey games but gameplay that plays much like *NHL '95* (Electronic Arts, 1994).

Figure 5.1: ***Heads Up Hockey*** **gameplay**



Screen capture, *Heads Up Hockey* (© David Goodman and Brad Paras, 2005, by permission).

5.1.1 Playing *Heads Up Hockey*

This difference between *Heads Up Hockey* and other hockey videogames lies in the fundamental purpose for which the game was created. In *Heads Up Hockey*, players get the puck from other players by "checking". In actual physical hockey, players use a number of strategies to obtain the puck from opposing players. They can use their sticks to poke at the puck to try to knock it away. They can lightly hook another player and hope the puck gets away then skate ahead and take the puck or sweep it to a team-mate. Another common strategy is to body check and opponent and "knock them off the puck". This strategy was adopted in *Heads Up Hockey*. To obtain the puck from an opponent, the player had to skate one of his characters into an opposing character and effectively loosen the puck before skating over the puck and gaining control.

The differences between *Heads Up Hockey* and other hockey videogames are a result of the educational goals that drive the design. *Heads Up Hockey* is a videogame designed to teach young hockey players about head concussion. Elements such as the checking cause the player to focus on areas of hockey that relate to this subject matter.

Built into *Heads Up Hockey* is a factor called "Karma". Karma is influenced directly by the participant's actions in the game. Performing actions that are deemed "good" will improve the Karma and improve the participant's opportunity to score and win the game. Performing actions that are deemed "bad" will reduce the Karma and cause the participant's players to play poorly.

By watching every action made by the participant, the code in the game can accurately determine what style of play the participant is employing. If the player chooses to perform actions that are dangerous and can cause concussions – actions such as high speed checking and checking goaltenders – the players Karma will be reduced. Performing successive dangerous actions will cause Karma to reduce at a greater rate. However, if the player avoids dangerous play, the Karma level will gradually rise.

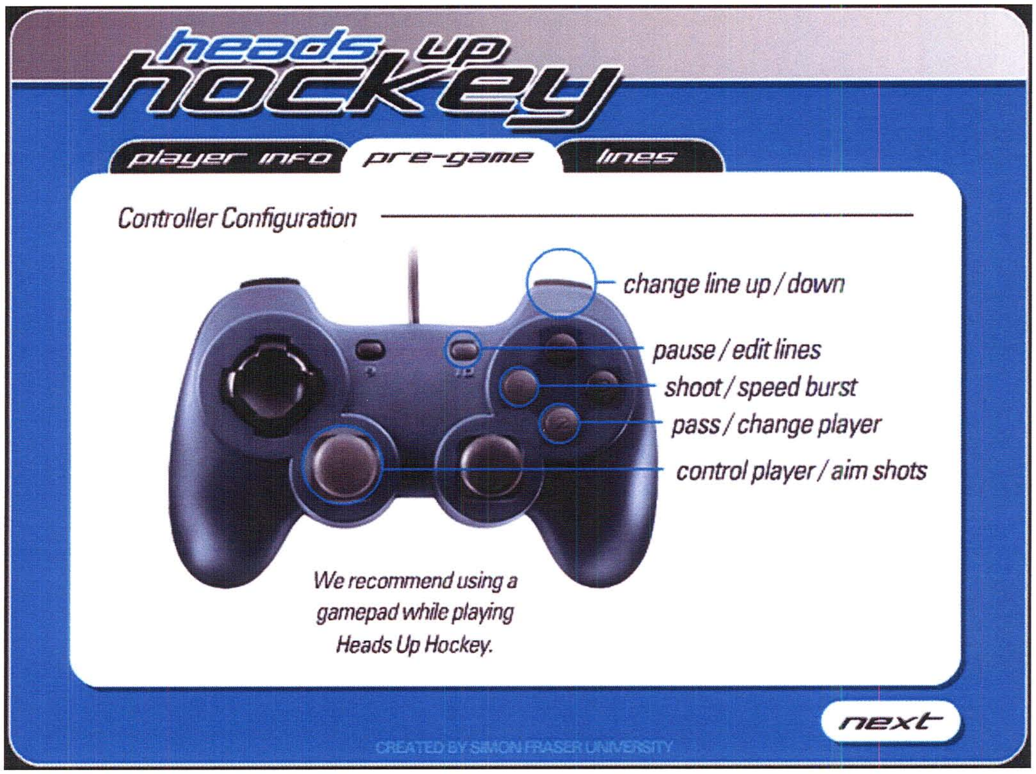
The 'karma' feature in *Heads Up Hockey* is one of the fundamental methods that the game uses to reinforce the idea that dangerous play is dangerous. Playing with tired, worn out players will cause players to become injured. If the participant does not remove a player from play, Karma will be reduced and more players will become injured, again reducing the player's opportunity to win. When players become injured, *Heads Up Hockey* displays one of ten cut-scene animations that discussion some of the causes and effects of concussions. The cut-scenes are thirty-second long animations that show player-to-player and player-to-coach interaction.

Before the player can engage in these high-level strategies for winning, a number of skills must be learned. During pilot tests of *Heads Up Hockey*, it became quite clear that players were unable to engage in the educational and strategic in-game decisions such as line management and injured player removal because they had become so focused on the operational decisions about how to make their players move, pass, and shoot.

5.1.2 Mastering the Controls

In *Heads Up Hockey*, there six buttons in total that can be used (Figure 5.2). Their functions are described in detail in the pages that follow.

Figure 5.2: Controller layout screen



Screen capture, *Heads Up Hockey* (© David Goodman and Brad Paras, 2005, by permission).

5.1.2.1 Moving the Player (Joystick)

To move players around the ice, players use a thumb-joystick that breaks down movement into eight different directions. Pushing the joystick up moves the player towards the top of the screen, pushing the joystick to the right moves the player towards the right of the screen. Since hockey is played on ice, the movement of the players reflects this. Players glide and take sweeping turns.

5.1.2.2 Passing the Puck (2 Button)

An important part of hockey is passing the puck to other players on the team. Passing helps move the puck towards the opponent's net and set up other players for good shooting opportunities since the goalie has to adjust to a new shooting positions when a pass is made. To pass the puck, the participant must first point the joystick in the direction he/she would like to pass, and then press the 2 button on the controller. The game will find the closest player within that directional pass cone and triangulate a passing direction that will cause the player to intercept the puck. Since hockey is a fast moving game, real hockey players must always pass ahead of their team-mates with precise timing.

5.1.2.3 Shooting the Puck (1 Button)

Another important part of hockey is shooting. Shooting is how players score a goal in hockey. In *Heads Up Hockey*, players shoot the puck by first aiming the joystick then pressing the 1 Button on the controller. The eight directions that the joystick can be aimed correspond with the eight corners/sides of the net. Pushing the joystick to the upper right will cause the player try to shoot the puck to the area known as the "blocker-side top shelf". Player attributes determine the accuracy of the shot. Some players can shoot more quickly and precisely than others can. There are two different types of shots available. Wrist shots are performed by very quickly pressing and releasing the shoot button. Wrist shots are the preferred way of shooting a puck from close range due to their accuracy and quick release. Slap shots are performed by holding down the shoot button for a longer duration of time. This causes the player to wind up and let off a very fast shot. These shots are better taken from further back and away from opposing players. One-timer shots can also be performed by passing to an open player then performing a wrist shot. This strategy is useful because it can really catch a goalie off guard.

5.1.2.4 Changing Players (2 Button)

At any time during the game, the participant controls just one of the eight players in the 3-on-3 game (3+3+2 goalies). The other seven players are controlled by computer artificial intelligence. During the game, however, participants may want to switch their control over to a player that is closer to the puck. To do this, the player presses the 2 Button on the controller. This action can only be performed when the player is not in control of the puck (otherwise, a pass will be executed). If the player tries to change players when he/she is already the closest player to the puck, the game will determine the next closest player and change control over to that player.

5.1.2.5 Speed Burst (1 Button)

Each player in *Heads Up Hockey* begins with full energy. As time progresses, the energy of each player will dwindle depending on the actions that player performs, the time on the ice, and their endurance. One of these actions is the speed burst button. By repeatedly tapping the 1 Button on the controller while not in control of the puck, the participant can give their currently controlled player a boost of speed that will help them get back into the play. Speed burst should be used carefully. If used too much, players will quickly get tired and need a rest. In addition, it is important that participants do not use speed burst to check into opposing players too frequently otherwise their Karma will also quickly decrease since speed bursting into another player causes dangerous high-speed checks.

5.1.2.6 Cycle / Change Lines (6 & 8 Buttons)

Since players get tired over time, it is important that they be rested. To do this, participants can change lines at any time during the game. There are three different lines on the team. The currently playing line is highlighted in the upper right hand corner of the screen. Pressing the 8 Button on the controller will move the current selection down. The AI players will begin heading towards the bench and trade positions with the resting players. Pressing the 6 Button on the controller will move the current selection up and the same actions will take place.

5.1.2.7 Face-Off (2 Button)

After a break in play, the game of hockey resumes with what is a called a face-off. In a face off, the centre players from each time face-off for a draw of the puck. They place the blades of their sticks into a circle then wait for the referee to drop the puck. When the puck drops, players fight for the puck by batting at it with their stick in attempt to pass it to one of their teammates. In *Heads Up Hockey*, the batting motion is performed by pressing the 2 Button on the controller.

5.1.2.8 Pause (10 Button)

There are times in the game when the participant may need to make some coaching decisions such as selecting players to remove from play. To do so, players can press the 10 Button on their controller to pause the game and bring up the line editor screen. When the game is paused, the on-ice action stops and the participant can begin adjusting line setups and analyzing game stats to determine a better winning strategy.

The above actions are the core skills that must be understood in order to win a game of *Heads Up Hockey*. In concordance with Bloom's Taxonomy (Bloom, 1994), after playing *Heads Up Hockey* for a while, these skills eventually become automatic and the participant is able to focus on higher level skills such as strategically determining passing plays or deciding how to juggle line setups for maximum performance. As well, it is at this level of aptitude when players can begin focusing on the educational gameplay mechanics - the health of their team and ways to play safer hockey.

5.1.3 Teaching *Heads Up Hockey*

As an educational tool, *Heads Up Hockey* requires multiple plays to become truly effective. As a game, it has inherent advantages such as the high replay value that caused by the excitement that each new experience brings. Still, it is important that the educational potential of the game be reached as quickly as possible and this depends on the ease at which the game can be learned.

Though nearly every videogame sold includes printed instructions, most rely primarily on in-game instruction. In-game instruction includes any instruction that is provided on the same media format as the game (i.e. instruction accessed via the menu system built into the game). Compared to the engaging action, interesting decision-making, and amazing graphics and sound of the game world, reading a printed manual does not have much appeal. Often when a game is purchased, it cannot be played immediately. It is in these times away from the playback device that printed material is read.

The participants who played *Heads Up Hockey* were exposed to both printed instruction and in-game instruction. The printed instruction existed in the form of a printed diagram illustrating the controller configuration. The primary method of instruction, however, is the in-game instruction. In all testing conditions, participants saw an additional controller layout graphic that offered an improved visual of the controller and complete button mapping. This diagram highlighted the actions indicated above such as shooting and passing. What the diagram did not do, however, is describe how and why to perform these actions.

In addition to the controller layout diagram, the experimental conditions were exposed to additional instruction. There are six key skills that when understood, we believed would help a player to win at *Heads Up Hockey*. These skills include changing lines, removing injured players, checking, shooting, performing one-timers, and using speed burst. Six individual instructional screens were produced to describe these skills. Each screen included two screenshots of the action, an animation of the controller being used to perform the action, and a written description of the action, which are as follows.

Table 5.1: **Written instruction seen only by the experimental conditions**

Title	Text
Line Changes	To keep your team healthy and fresh, frequently change your lines (6 and 8). Well-rested players not only **play better**, they are also **less prone to injury**.
Injuries	When a player is injured, a **Red Cross** will appear over his head. Pause (10) the game and use the **line editor** to remove the player from play.
Checking	To **get the puck** from another player, skate into them to **check** them. Be careful though, skating too fast into another player is dangerous.
Shooting	To take a **slap shot**, hold down the shoot button (1). To perform a **wrist shot**, very quickly tap the shoot button (1).
One-Timer	**Pass** (2) to an open player, then quickly tap and release the **shoot** button (1) to execute a **one-timer**.
Speed Burst	Tapping the **Speed Burst** button (1) when you are not in control of the puck will give your player an extra **burst of speed**. Be careful though, speed bursts require extra **energy** and can cause **painful collisions** with other players.

Each instruction was designed to be easily read. Key words were set as bold and controller button indicators were displayed in blue to help them stand out (Figure 5.3). In addition to these instructions, two additional screens were displayed – one before and one after the previously described screens (Table 5.2). All conditions, including control, were exposed to these instructions.

Table 5.2: Written instruction seen by all conditions

Title	Text
Pause Information (First Instructions)	Press the **Pause** button (Esc or 10) to pause the game at any time during play. This will enable you to **view stats** and **change line setups**.
Line Editor (Last Instruction)	If a player sustains an injury during the game, you are able take the injured player out of the game and **double shift** a healthy player. Now, press next to use the **line editor** and drag nine healthy players from the roster to open positions.

5.1.4 The Conditions

The experiment included three conditions – control, before-play, and in-play. Table 5.3 illustrates the flow of instruction for each condition.

Table 5.3: Sequence of instructions as seen by each condition

Control Controller layout diagram > Pause Information > Line Editor > Game
Before-Play Controller layout diagram > Pause Information > Line Changes > Injuries > Checking > Shooting > One Timers > Speed Burst > Line Editor > Game
In-Play Controller layout diagram > Pause Information > Line Editor > Game > Context-sensitive Instruction

5.1.4.1 Control

Nearly every game provides some basic instruction about controller layouts. Therefore, the control group in this experience was exposed to a controller layout diagram. They were then shown that they could pause the game to change lines and view stats. Finally, they were told about how to use the line editor and remove/change injured players. This basic information is enough to play the game without too much frustration. As a control condition, it accurately represents a player of typical video game skipping any form provided instruction and jumping right into the game.

5.1.4.2 Before-Play

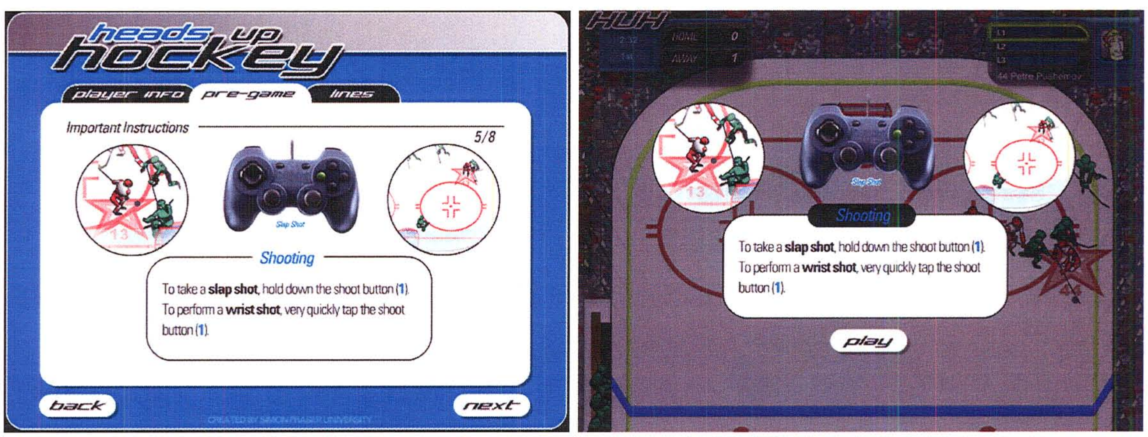
The before-play group was exposed to all of the instruction that the control group was exposed to, however, additional instruction was also provided before the game began. This instruction was provided between the 'Pause Information' instruction and the instruction on how to use the line editor and remove/change injured players. To advance through each page of instruction, the player simply clicked a button labeled "next". Participants could read at his/her own pace and it was not required of them to read each page.

5.1.4.3 In-Play

The group exposed to the in-game context-sensitive training began their instruction the same as the control group. Minimal instruction was provided prior to the gameplay experience. However, once the game began, each participant's actions were carefully recorded by the game. By watching what each participant was and was not doing, the game was able to provide timely instruction when the participant needed it. The instruction provided was identical to the six additional pages of instruction provided to the before game group.

The intelligent teaching process is based on a graduated learning approach (Appendix B). There are six skills to be learned. Each participant begins at Level 1 in each skill. Level 1 assumes that the player has no knowledge of the skills and has not been exposed to any instruction. If the game determines that the participant is not performing a skill that he/she should or could be, it pauses the game when the player is not in control of the puck, and it displays the appropriate instruction. The only difference between the actual instruction presented to the during play group and the before-play group is that instead of being displayed in the front-end user interface, the instruction is presented with the action faded in the background.

Figure 5.3: Example of before-play and in-play shooting instruction



Screen captures, *Heads Up Hockey* (© David Goodman and Brad Paras, 2005, by permission).

After reading the instruction, the participant can press a button labeled "Play" to return to the action and apply their new knowledge. The game then moves the participant to Level 2 for the specific skill. Level 2 assumes that the player has been exposed to some instruction and is developing skills in that area. In Level 2, the game checks to make sure that the participant is applying their newly learned knowledge. If the player shows no improvement, he/she is shown the instruction again and must start from the beginning of Level 2. If the player successfully performs the taught skills, he/she eventually moves to Level 3 where it is assumed that the player understands the specific skill and no longer needs instruction. When all skills reach Level 3, the player has become competent with the game and is able to begin focusing on high-level skills and additional aspects of the game such as the educational component.

5.2 Purpose

For the purposes of this study, certain features available in *Heads Up Hockey* were disabled. The aim of this study was to determine which in-game instruction methods maximized player performance and satisfaction. Players were asked to play one game comprised of three 3-minute periods. It was in this short time that we captured all data. Since new players are less likely to understand which actions are 'good' and 'bad', they have a propensity to accumulate bad Karma. The influence of Karma would affect our ability to track player learning so this feature was disabled. The other educational component – the cut-scenes – was also disabled since it served no purpose in this testing. For this testing, the goal was to determine the best method for learning how to play *Heads Up Hockey*, not learning about concussion.

There were two primary purposes for this study. First, we wanted to determine which instructional method enabled for the greatest participant performance. It was assumed that those who understand the game better and are closer to being able to engage in the educational content will naturally perform better. Second, we wanted to determine which instructional method allowed for greatest participant enjoyment. Learning how to play a game is part of what makes a game fun (Gee, 2004). Therefore, it was important to us that we understood which instructional method was most successful at creating an enjoyable experience.

5.2.1 Performance

To determine participant performance, a number of factors were recorded. The primary purpose in playing *Heads Up Hockey* is to win. All decisions made and actions taken along the way are secondary to the aim of scoring more goals than the opponent scores. For this reason, the primary performance measure we chose for determining participant performance was goal differential. We obtained this measure by subtracting the opponent's final score from the participant's final score. This gave an immediate and clear picture of the differing results between instructional methods after just a single play-through of *Heads Up Hockey*.

Performance was also looked at in other ways. The time of each goal by the participant was recorded so that a curve illustrating the participant's learning curve could be formed. This way we could determine the rate at which participants from each condition were learning throughout the entire learning experience.

The individually taught skills were each independently tracked. Total line changes, successful removal of injured players, checks, shots, and one-timer attempts were all recorded. Due to a glitch in the software, information about the use of speed bursts was deemed unusable and could not be used. By looking at each of these skills, we could see the effect of the training provided by each of the conditions tested.

5.2.1.1 The Influence of Artificial Intelligence

Unlike tests and other methods of performance evaluation, games involve the use of artificial intelligence (AI), which will influence the outcome of any given game. Though AI makes its decisions based on a number of pre-set rules, the decisions of which rules to make and the results of these decisions are not necessarily completely pre-determined. A degree of randomness is interwoven throughout every game of *Heads Up Hockey* and this influence of chance is what makes games interesting. Chance is an important element in every game as it keeps the player focused on the experience at hand by introducing uncertainty. For these reasons, it is important to note that the final performance of the player could be influenced by chance. For example, by chance, the computer opponent could have a higher shooting percentage and end up winning due to this.

Despite the influence of chance on the final score of the game, the tracking of individual skills enables us to look at player performance more specifically because these elements are directly affected by player decision and not by chance.

5.2.2 Enjoyment

To determine the participant's enjoyment of the game, a post-game questionnaire was used. Upon finishing the game, the participant was asked to answer questions about their experience with games and whether they would like to play *Heads Up Hockey* again. There were then asked to complete the Flow State Scale (Marsh & Jackson, 1996). This scale is used to determine the degree to which a certain experience enables a person to enter the flow state. Using a Lickert scale, the participants were asked to answer from 1 to 5 (1 being "strongly disagree", 5 being "strongly agree") on 36 questions about their experience. The wording of the questions was modified slightly to make them easier for younger children to read, and to make the questions pertain better to a gaming experience since the original scale was written for physical athletic performances (see Appendix A).

5.3 Participants

All participants were students from three different elementary schools in Vancouver, British Columbia, Canada. The students were in grades 4-7 and had a mean age of 10.5 with a standard deviation of 1.1. In total, 157 students participated in the study. Due to a bug in the game caused by atypical user interaction, the data from two participants was removed. The final sizes for each group were: Group 1 = 51; Group 2 = 57; and Group 3 = 47. The reason for the differing sizes is explained in detail below.

5.4 Procedure

Ten laptops were laid out on tables and setup so that the conditions alternated (1, 2, 3). Since there were an uneven number of laptops, the 10^{th} laptop was set to the condition with the least participants recorded at the time of setup. Even with this precaution put into place, perfectly even group sizes could no be established as illustrated above. Participants were asked to select a computer and begin by signing into the game. Typical seating styles involved boys sitting with boys and girls sitting with girls. Alternating the conditions ensured an even distribution among the groups. The final gender ratios (0 being male, 1 being female) for each group were: Group 1 = 0.43; Group 2 = 0.4; and Group 3 = 0.38.

While signing in, participants were instructed to wait once the game began loading so that all participants could begin at the same time. The following instructions were read aloud:

Thank you everyone for participating in our study. We are testing different forms of in-game training to determine which produces good gameplay. Before you begin playing, we'd like to give you a few instructions. You will begin by creating an account. This is necessary for playing the game because it is used to record information about your interaction with the game. After your account has been created, you will be logged into the game. Please stop and wait at this point.

To ensure that all participants were first-time players of the game, there was a question during the sign in process that asked whether they had played *Heads Up Hockey* before. If a participant selected 'Yes', the sign-in process was halted. If 'No' was selected, the game began loading up. This safeguard was useful in one situation where a student who had played the day before wanted to play again the next day. The student's new data was immediately removed.

Once all players had signed in, a researcher got the student's attention and informally asked how many students, by show of hands, had played a hockey video game before. This method was used to encourage the participants to interact with the researchers so that they would feel comfortable to ask if they had any questions or concerns. Approximately half the students indicated they had played hockey video games before. This informal poll was validated by a question in the post-game question that asked whether this game was similar to games the participants normally play. Fifty-five percent indicated that 'Yes', it was similar to games that they normally played. The researcher then explained to the participants what they would be doing, stressing the effect that instruction can have on in-game performance. The following was read:

Closely follow the instructions since this will help you to play the game better. Once the game begins, take note that you will be controlling the red team. When the game is finished, you will be asked to answer some questions. There are about 40 questions in total, but they're easy to answer so please answer them all. When you have answered all the questions, you can choose either a puck or a bag of chips as a prize. If you have any difficulty answering any of the questions, please ask a researcher to help you out. You are not required to participate, so if at anytime you decide that you would not like to participate, please raise your hand and tell me or the other researcher. Choosing to not play will not adversely affect on your school grades in any way. Please begin and have fun!

At this point, the participants began reading the instructions and playing the game. The researchers noticed that some players would automatically use the directional pad on the game pad as opposed to the joystick even though this was explained in the instructions. Such players were informed once that they should be using the joystick to control the in-game players. Once the pre-game instruction was read, participants were required to setup their lines. If the researchers noticed a participant was spending a lot of time during this process, they were notified of the "Default Lineup" button, which automatically sets up the lines.

During play of the game, if participants asked questions about how to play the game, they were told to refer to what they were told in the instructions. If the participant was from Group 1 or 2, this meant remembering what they had read prior to playing the game since the instruction could not be accessed once the game began. When all three periods were up, the players were shown some statistics then brought to a post-game questionnaire. The questionnaire began by gaining some information about their past-experiences with videogames then continued with the Flow State Scale questions.

The Flow State Scale was initially developed for sport and physical activity settings and it addresses the research difficulties of applying empirical methods to phenomenological experiences. By breaking down Csikszentmihalyi's theory of Flow (1990), an experiential state where the person becomes very involved in an activity, into nine dimensions, each questioned four times, Jackson and Marsh (1996) were able to use Confirmatory Factor Analysis to valid a post-experience, 36-question questionnaire.

5.5 Results

5.5.1 Goal Differential

Our primary performance metric was the training's impact on goal differential. Goal differential is defined by the participant's goals minus the computer's goals. A highly skilled player should have a positive goal differential and win the game. Therefore, we looked for an increase in goal differential in Group 2 (before-play) and Group 3 (in-play) over Group 1 (control) ($\bar{x}1$ = -4.00,

$\bar{x}2 = -4.02$, $\bar{x}3 = -2.89$). There was a significant difference between Group 1 and Group 3 ($t = -1.72$, $p < 0.05$). Despite the fact that Group 2 saw the same instructional information as Group 3, there was no significant difference between Group 1 and Group 2 (Table 5.4).

Table 5.4: Goal Differential

Condition	N	Goal Differential	Standard Deviation	P-Value
Group 1	51	-4.00	3.08	-
Group 2	57	-4.02	2.82	0.49
Group 3	47	-2.89	3.28	< 0.05

Independent one tailed t-test, comparing Group 1 versus Groups 2 and 3, significant alpha < 0.05

5.5.2 Individual Performance Skills

We also recorded individual skill performance to determine whether or not the use of the instructional aids led to changes in performance (Table 5.5). Of the five skills, significant differences were found in line changes ($F = 3.8$, $p = 0.023$) and substitutions ($F = 22.7$, $p < 0.0001$). A Tukey post-hoc test for line changes showed that Group 3 was significantly different than Group 1 ($p = 0.02$). The same test run on substitutions showed that Group 3 was again significantly different than Group 1 ($p < 0.0001$).

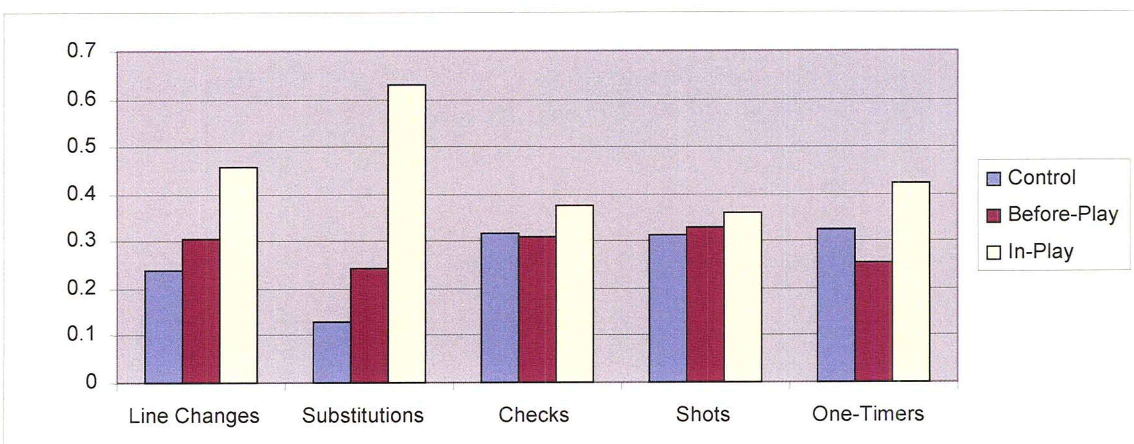
Table 5.5: Individual Performance Skills

Condition	Line Changes		Substitutions		Shots		Checks		One-Timers	
	Mean	p-value	Mean	p value	Mean	p value	Mean	p value	Mean	p value
Group 1	13.94	-	0.49	-	12.35	-	3.27	-	0.33	-
Group 2	17.82	0.330	0.93	0.139	12.96	0.467	3.19	0.492	0.26	0.433
Group 3	26.66	0.01*	2.43	0.000*	14.19	0.284	3.89	0.210	0.43	0.381

One way ANOVA, Tukey's test, significant alpha < 0.05

Despite the lack of significant differences between groups in the individual skills, an analysis of the means showed a consistent positive trend wherein the results for Group 3 were in the hypothesized direction (Figure 5.4). Group 3 had the greatest means for Line Changes, Substitutions, Shots, Checks, and One-Timers (Figure 5.4).

Figure 5.4: Percentage of moves performed by group



5.5.3 Ignoring Instruction

It became evident during the testing that some participants were not reading the instructions. The in-play instructional system was designed to address the player's inability to perform by providing instruction that corrects inappropriate actions. Assuming that those who read the initial instructions would make fewer incorrect actions, those players who actually read the instruction would, in the end, see less instruction than those who simply ignored the instruction. In order to assess this, we tested for correlation between goal differential and the number of times that instruction was presented. The results showed a negative moderate correlation ($r = -0.44$, $p = 0.002$). Among skills that were more closely monitored, the probability of this happening was significant (Line Changes: $r = -0.537$, $p < 0.0001$; Substitutions: $r = -0.351$, $p < 0.0001$; Checking: $r = -0.311$, $p = 0.033$).

The negative correlations support the hypothesis that players who do not read the instruction will tend to see more instruction during the game since they do not correct the action necessary to prevent the instruction from being triggered. Not only do they perform more poorly on the specific skills that they are being taught, but their overall performance (goal differential) is also negatively impacted.

5.5.4 Player Enjoyment – The Flow State Scale

We were also interested in determining what effect the training would have on the player's overall enjoyment and immersion within the game. Prior to embarking on the study, we identified two potential extremes: 1) the training would increase player ability, matching skill more closely to challenge and enhancing the experience, or 2) the training would interfere with the player's immersion into the experience due to its invasive behavior (the common opinion about in-game training). To test for player enjoyment, we looked at flow by testing each participant with the Flow State Scale.

The results obtained from the 36-question test showed no significant difference among the three groups (Score out of five: $\bar{x}1 = 3.64$, $s1 = 1.12$; $\bar{x}2 = 3.70$, $s1 = 1.06$; $\bar{x}3 = 3.77$, $s3 = 0.96$). Even though the in-game training paused the hockey game and interrupted the play state, most of the participants did not find the experience any less enjoyable. If training is beneficial to the player, overall it can make the experience just as, if not more, enjoyable.

There was a moderate negative correlation between enjoyment (Autoletic Experience) and the number of times that the participant saw the instruction ($r = -0.353$, $p = 0.015$). This finding suggests that some players ignore instruction. Players who ignore instruction early see it more later on. This has a negative impact on player experience. Had these players read the instruction instead of ignoring it, their experience may have been improved.

Table 5.6: Flow State Scale

Condition	1	2	3	4	5	6	7	8	9	Aggregate Flow Score
Group 1	3.49	3.47	3.66	3.61	3.75	3.56	3.72	3.48	4.07	3.66
Group 2	3.5	3.43	3.84	3.59	3.79	3.79	3.71	3.43	4.2	3.71
Group 3	3.63	3.54	3.82	3.72	3.79	3.88	3.79	3.57	4.19	3.77

Descriptive statistics for flow state. (1 = Challenge; 2 = Action Awareness; 3 = Clear Goals; 4 = Unambiguous Feedback; 5 = Concentration; 6 = Sense of Control; 7 = Loss of Self; 8 = Transformation of Time; 9 = Autoletic Experience)

5.5.4.1 Improving Enjoyment

Using the autoletic experience mean score as an indicator for player enjoyment, I was able to look at which factors affected the experience. There was a positive correlation between enjoyment and goals for (r = 0.18, p = 0.025) and a positive correlation between enjoyment and puck carrier hits (r = 0.218, p = 0.006). To confirm that players enjoyed the game when they understood how to take control of the puck by checking opposing players, I ran a correlation between enjoyment and attack time and again found a positive correlation (r = 0.181, p = 0.024).

Table 5.7: Enjoyment Correlation

		Total Hits	Autoletic	Home Attack Time	Goals For
Total Hits	Pearson Correlation	1	.218(**)	.308(**)	.372(**)
	Sig. (2-tailed)		.006	.000	.000
	N	155	155	155	155
Autoletic	Pearson Correlation	.218(**)	1	.181(*)	.180(*)
	Sig. (2-tailed)	.006		.024	.025
	N	155	155	155	155
Home Attack Time	Pearson Correlation	.308(**)	.181(*)	1	.321(**)
	Sig. (2-tailed)	.000	.024		.000
	N	155	155	155	155
Goals For	Pearson Correlation	.372(**)	.180(*)	.321(**)	1
	Sig. (2-tailed)	.000	.025	.000	
	N	155	155	155	155

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

5.5.5 Summary

The results of the study showed increased player performance among those who were exposed to in-play training when comparing goal differential between the three groups. The results also showed that before-game training had no effect on player performance. There were no significant differences among the three groups when testing player performance via the Flow State Scale. These results are discussed in detail in the following chapter.

6 DISCUSSION

The results from our study indicate that in-play training can provide players with more effective training that can improve their chances of winning by improving goal differential. Perhaps equally as important was our finding that training before play has no impact on player performance. As videogames become increasingly more complex, effective training approaches are essential to creating games that are manageable and enjoyable for the player. The results from our study provide game developers a starting point from which to base their training design. Though the effect of in-play training may vary form game-to-game, our findings suggest that the in-play approach to training is effective in some games,

6.1 Performance

6.1.1 Positive Trends in Performance

A direct result of effective instruction is improved player performance. The goal of instruction is to teach the player about how to play so that they do not become frustrated and unwilling to continue playing. Since we set out to determine which method of instruction is best suited for teaching players how to play, we looked at player performance and enjoyment. On average, players who were taught via in-game instruction were over one goal closer to winning than those who did not see the additional instructional screens.

Since most games provide players with some basic form of reference such as a controller layout diagram or brief overview of the rules, we provided each group with such information. By doing so, we were, in essence, looking at the impact of teaching the player some of the advanced skills that are specific to our game. As for the basic controls, players learned these via the controller layout diagram that was shown prior to additional instruction. We recognized that since most games already provide such instruction, this would limit the observable effect of our in-play training approach. Therefore, we counted on the six skills that we identified to have an influence on player performance. After just a single game, a significant improvement was observed.

6.1.2 Observed Advantages to In-Game Training

As we carried out the experiments and reviewed the data, we observed a number of key factors that resulted in positive changes in behaviour and in-game performance among participants of the in-play groups. We believe that these changes are directly related to the training experience that they underwent. From these observations we devised principles that can be applied to other training systems. If these principles are applied, players will be more likely to understand what is being taught, enjoy the learning experience, and spend more time applying what is learned.

6.1.2.1 Spread-out instruction is more likely to be understood

Players who were presented the instructional screens prior to playing the game often became tired of reading and skipped some of the latter screens.

Skills that were presented earlier in the sequence of screens had a greater performance difference between Groups 1 and 2, with Group 2 having higher averages. Skills presented later in the sequence showed little difference between the two groups. Players lose interest when information is presented before they have had the opportunity to practice and apply what is learned. On the other hand, Group 3 consistently performed, on average, better than both Groups 1 and 2 in all skills assessed. While before-play training may have some effect on player performance, the dynamic nature of in-play training does not require the player to remember information prior to engaging in the actual experience.

6.1.2.2 Instruct only what needs instructing

During the experiment, some of the participants asked how to perform specific manoeuvres. We were able to determine which group the participants were assigned to based on what type of instruction appeared on screen. Though we could not respond to their questions with answers, we were able to observe what they were doing. Groups 1 and 2 were more likely to ask questions once the game started. Many of their questions would have been answered had they read the before-game instruction.

Group 3, however, was able to focus on the game more intently because the game code evaluated what they needed to know and presented the appropriate answers. The only questions asked by Group 3 were related to why the pop-ups kept coming up. Even though they were constantly reminded about how to perform, some participants from Group 3 neglected to read the pop-ups. As a result, these participants continued to perform poorly. We did not inform these participants prior to playing that reading the instruction and following what was written could prevent the instruction from coming up again. If we observed participants that were overtly struggling, we encouraged them to “read the instructions”. Most of the time, this simple reminder caused them to correct their innate response to skip the instruction and figure it out on their own.

6.1.2.3 Training works best when the player ‘wants’ it

One of the greatest observed advantages to in-play training was the ability for the game to present instruction to the player when they want it. Prior to playing the game, all the player wants to do is get in and try out the game. Once they begin playing, they begin to understand what it is that they do and do not know. As they begin to understand this, so does the game. The game chooses a proper time to display the information and the player is hardly ever left wondering how to do something.

6.1.2.4 Situated training leads to improved time management and play-learn balancing

Applying smart instructional techniques is also beneficial in situations where time is limited. If the in-game training system is intelligent, it can identify which skills the player does not need instruction for. The player can quickly enter gameplay and be taught only what he/she does not already know or understand. As a result, players spend more time playing and less time reading, watching, or participating in training. In our experiment, there was limited time for the players to learn and play the game. Except in some rare cases where participants completely ignored the training, Group 3 completed the experiment in about the same time as the other groups. Moreover, since the training system is intelligent and continually monitoring what the player is doing, a player can leave the game for a few months and when he/she returns, the game will only teach skills that have been forgotten.

6.2 Player Enjoyment

One of the ultimate goals in game design is to create a game that players enjoy and come back to. When asked if they would play the game again, 88% of Group 1, 93% of Group 2, and 94% of Group 3 indicated that they would like to play the game again. For an educational game designed to teach about concussion, these are high numbers that reflect the quality of the game experience.

Interestingly, the two groups that were shown the additional instruction were both more likely to want to play the game again. Though not statistically significant, this finding illustrates that training could potentially have a positive effect on a player's enjoyment level while playing a game. Even though the instruction was presented in an invasive way (pausing the game and presenting a pop-up) for the in-play group, it did not jeopardize the player's desire to play the game more.

6.2.1 Flow

One of the key indicators of player enjoyment is the ability of the game to support the "flow" state. Similar results were found when comparing scores between the groups on the Flow State Scale questionnaire (Table 6.1). Of the three conditions, Group 3 had the highest overall average and scored the highest in seven of the nine independent factors. Group 2 exceeded Group 3 in two of the factors, however the differences were minimal.

Table 6.1: Flow State Scale Averages

Group	1	2	3	4	5	6	7	8	9	Average
1	3.49	3.47	3.66	3.61	3.75	3.56	3.72	3.48	4.07	3.65
2	3.50	3.43	**3.84**	3.59	**3.79**	3.79	3.71	3.43	**4.20**	3.70
3	**3.63**	**3.54**	3.82	**3.72**	**3.79**	**3.88**	**3.79**	**3.57**	4.19	**3.77**

Of the nine independent factors, the average scores for the *autoletic experience* questions (Question 9 in Table 6.1) were considerably higher than the rest. These questions focused on the perceived enjoyment of the experience by the player. When one enters the flow state, the experience is highly enjoyable and rewarding and therefore, asking such questions can help determine whether one has entered flow state. The questions for autoletic experience were:

- I really enjoyed the experience.
- I loved the feeling of that playtime and want to feel like that again.
- The experience left me feeling great.
- I found the experience extremely rewarding.

The groups that saw additional instruction both scored higher than the control group, indicating that on average, those who viewed the extra instruction found the experience more enjoyable. Though training is sometimes looked upon negatively by game players, the results from our data seem to indicate a different story. In games, understanding how to play can have a considerable impact on a player's ability to enjoy the experience. Training can help to alleviate frustration and feelings of being overwhelmed.

A review of different training methods and their impact on player enjoyment would be of great value to the gaming industry. Such information would help game designers make informed decisions about what approach to take in order to maximize enjoyment. The results of our studies suggest that effective training approach can positively influence player enjoyment. Therefore, the creation of an effective training system is important when developing videogames.

7 DESIGN PRINCIPLES

Our findings, which were based on the manipulation of instruction in a sports-action game, may have implications for not only videogames in general, but other educational initiatives. In this chapter, which should be considered somewhat speculative, we posit our views on the relevance of our studies to a much broader audience.

7.1 Videogame Genre and Training

When designing an effective training system, one must consider for what type of game the system is being developed. When designing a system for *Heads Up Hockey*, we considered a number of factors including presentation, time of training, implementation difficulty, and content. Up until very recently, an in-game training system in a sports videogame was unheard of. We decided to take a chance at developing an in-game training system within a genre that had not seen such approach before as a way to demonstrate how extensible in-game training could be. We found out that even though the approach we took was not overly difficult to develop, the results were positive and the training worked.

However, the final implementation of in-game training within different genres will differ due to ways that different games play and how external factors such as training can affect the flow and balance of such games. Listed below are some examples of in-game training systems that could be applied to a variety of genres.

7.1.1 Sports Games

Sports games require the player to understand a large collection of rules prior to engaging. If the player is unaware of these rules, he/she can be penalized for making mistakes. The rules are specific to the sport and most sports videogames assume that the player understands these rules. In addition to understanding the rules, players develop specific strategies. This is where training comes in. Players need a way to learn how to apply the strategies that they know within the game environment.

As we discovered with *Heads Up Hockey*, there are certain skills that will help the player to win the game. In *Heads Up Hockey*, effective line changes can provide a significant benefit to the player since he/she will be playing with players who have much higher energy levels. In other hockey videogames, critical skills include one-timers, deking, and shot blocking. To develop an effective in-game training system for a sports game is to create a system that analyzes the behaviour of the player and informs the player about key skills at the appropriate time.

7.1.1.1 Design Keys

- **Present an overview of the controls before play** – Before playing, players need a quick way to learn all the manoeuvres they can perform in the game. A controller diagram provides a quick way for gamers to familiarize themselves with the basics or re-learn advanced skills. Save in-game training to teach when and how to perform the skills effectively.

- **Do not expect the player to engage in the training content while the game is in play** – Training should exist outside of the actual realm of play. If training pops up while the game is active, it could distract the player and cause his opponent to score.
- **Minimize disruption** - If implementing an in-game training system that presents the training during play, make sure that it is activated while the player is not on the offensive. Pausing the game while the player is formulating an opportunity to score will do three things: 1) It will frustrate the player because of its negative influence, 2) It will likely be ignored because it most likely will not be related to the current goal of the player, and 3) Since the training may not be directly related to what the player is doing, the training system will as appear to be incompetent at effectively providing instruction. Present training information when the opponent is on defense or during stoppages of play.
- **Judge necessity of instruction** – Do not constantly provide training for a skill that is very difficult to perform and not necessary for winning. Conversely, if a skill is extremely important, it should be presented early and often until the player demonstrates an understanding of the skill.

7.1.2 Linear Narrative-Based Games

When developing training systems, it is often advantageous to present information in some pre-determined order so that complexity gradually increases with each new piece of information. Textbooks demonstrate this principle. In most textbooks, learners start with basic skills then gradually are presented more detailed instruction for more complex skills. The linearity helps the instructional designer select what order the material should be presented in for the best possible learning experience.

For these reasons, linear narrative-based games (adventure, action) are an ideal platform for in-game instruction. Right up until the end of the game, instruction can be presented whenever a new skill must be performed. The game designer can spread out skills and simply present information the first time that the player is able or required to perform the skill. This way, basic skills/ challenges and the appropriate instruction can be presented early in the game. As the player's skills develop, more advanced training can be provided. All training is presented at the moment it is to be applied.

Many games employ narrative as a method for progressing the game. These mini-narratives are linear in nature and can be used to support the training. In some games, such as *Grand Theft Auto 3* (DMA Design, Rockstar Games, 2001), the player must attend a training academy or mini-game within which the skills are learnt. Often, the narrative will require the player to perform a specific action. At this moment, training text can appear on the screen, informing the player about the basic mechanics of the action (which buttons do what) and letting the player determine and execute a successful strategy.

When developing training systems for these types of games, one should always conform to the narrative and gradually introduce new actions with increasing complexity. The information should not interfere with the narrative, but instead should be essential for helping the player progress and move forward.

7.1.2.1 Design Keys

- **Teach frequently used skills first** – Some skills, such as navigating the game world, are skills the player will need to use at all times during the game. These skills should be introduced to the player very early in the training so that the player doesn't become frustrated and so he/she has adequate time to develop his/her skills.
- **Space out training to prevent overwhelming the player** – If a player is taught something but not given enough opportunity to practice and develop their skills before being presented additional instruction, they can quickly become inundated. Spacing-out the introduction of new skills can help pace the game and the learning experience. Some players will want to know how to do everything at once, but most would rather perfect one skill before moving onto the next. Establishing a game design that supports this can be very rewarding for the player and prevent less skilled players from becoming overwhelmed and quitting.

- **Use narrative to drive the training** – When players engage with videogames and enter the Magic Circle, it is important that things external to the narrative do not interrupt the experience and take the player out of the moment. Therefore, it critical that training is integrated with and driven by the narrative. The narrative can be designed so that new actions are gradually introduced or the narrative can include mini-games or even in-game training academies that are in-line with the story taking place in the game world.
- **Do not pause the game unless absolutely necessary** – Design the game so that the training can be presented without interrupting the flow of the game. Abruptly halting game-time (Juul, 2004) can be viewed as intrusive by the player and can prevent him/her from engaging in the content. This is because he/she will likely want to continue playing rather than interface with content outside of the game world.

7.1.3 Multiplayer First-Person Shooters

Rather than face computer opponents, many players would now rather face the intelligence of other humans online. Online multi-player games have become so popular that in some games, the single-player component was merely an after-thought by the developer. A good example of this is *Battlefield 2* (DICE, Electronic Arts, 2005), a team-based multiplayer first person shooter that included a single-player game with a reduced number of maps and bots with poor intelligence. In single-player first person shooters, in-game training can be implemented in the same way that it is done in other linear, narrative-based games. However, in multi-player experiences, gameplay is much more emergent and therefore, the training environment cannot be as structured.

Despite the unpredictable nature of multiplayer games, successful in-game training can still be achieved. Careful monitoring can allow the designer to learn what the player needs to understand. Inserting triggers for context-sensitive events or presenting instruction based on the time the player has spent playing game can provide a balanced learning experience for the player even within the chaos of these games.

7.1.3.1 Design Keys

- **Insert context-sensitive triggers** – Adding triggers that detect the first time a player has entered a mode that offers new controls (throwing grenades, climbing ladders, reloading a weapon) can help the player learn skills that are necessary to pass the challenge in-front of him/her. Since each player experiences the challenges in a different order, triggers allow the training system to adapt in real-time.
- **Space out training by tracking play time** – Time is an effective way to spread out training so that the player isn't overwhelmed with information. This method of instructional delivery should only be reserved for skills that cannot be triggered by context-sensitive triggers. Important and basic skills should be presented early on, and advanced skills should be saved for later when the player is competent with the basic skills required to play the game.

- **Minimize player distraction** – In a multiplayer game, the last thing a player wants is something distracting him/her. Rather, players want whatever they can take to help them win. Instruction should be very informative but to the point, and it should not interfere with what the player is doing.

7.2 What Educators Can Learn

Instructional designers can also benefit from understanding what it is about games and their embedded training systems that make them so effective for teaching players young and old. There are many, many things to be learnt from videogames, however, such research is beyond the scope of this thesis. Nonetheless, three key ideas emerged from my research that I believe educators can use to enhance their teaching.

7.2.1 Make Them Want It!

One of the things that videogames do best is make the player want to learn. When designing instruction, try to establish a situation that builds up within the learner a desire to learn. Videogames do this by presenting very unique and interesting scenarios the player must interact within. The player knows that if he/she tries hard enough, he/she will succeed. These factors and the events leading up put the player in a state of wanting to move forward and succeed. This state is what encourages the player to learn. If they want it, they will learn it and this type of scenario is what all training should strive to accomplish.

The key to creating 'want' is reward. Fortunately, reward comes in many forms and does not have to exist outside of the learning. Videogames demonstrate that the learning experience itself can be rewarding enough to encourage the learner to continue engaging. The personal satisfaction of learning something and performing well can make the learner want more. Unfortunately, much training is so improperly balanced that players often do not have the opportunity to apply what they have learnt. As a result, there is no immediate reward for learning. In *Heads Up Hockey*, Group 2 was forced to engage in all learning prior to entering the game. In essence, the reward for reading one screen was yet another screen of information. In contrast, Group 3 read one screen then was able to test what they learned and reap the reward of being able to play better.

The content being taught should be relevant to the situation at hand. If the content is perceived as irrelevant, it will quickly become boring and uninteresting. The best way to make content interesting is to make sure that the learner understands why they are learning it. Presenting the big picture before and during the training will likely improve the learner's understanding of how things work together and what significance they have.

Teaching in-context is a good way to ensure that the player understands why they are learning something. If a player in a videogame encounters a crevasse that they must leap over, they are much more likely to understand the significance of long-distance jumps in the current situation rather than during a series of training screens placed in an arbitrary situation. Always ensure that the learner understands why it is that they are learning something; the 'why' will more often than not make them **want** to learn.

7.2.2 Provide Ample Opportunity to Apply

The primary goal in game design is the creation of meaningful play. To create meaningful play, designers must support both discernable and integrated actions. Discernable actions ensure that the player understands the immediate impact of their choices. Integrated actions are those that have long-lasting impact in the relative scheme of things. I believe that these ideas apply to general education as well. For learning to become meaningful, the learner must be able to discern what they have learned beyond what they encountered in the training material. Learners also need to understand the long-term impact of what they have learned – the integrated influence on their own lives.

To discern when and how to apply what they have learned, learners need opportunity to apply what they have learned. It is important that these are opportunities are not separated from original training otherwise information can get lost. Since the training that Group 3 got was integrated within the game environment, players were able to apply what they had learned instantly. When learning about line changes before the game, it is likely that some players from Group 2 did not understand the impact of the information presented. Group 3 players, however, could instantly change their line and get a fresh set of players on the ice, increasing their chance of scoring. This is one of the greatest advantages to training within videogames. Everything that is learned can be tried out within the environment is meant to be applied.

With so much to learn in so little time, it is valid to argue that there just isn't time to apply everything that has been learned to situations that resemble those in which one might use what was learned. No learner is ever going to apply all that he/she has learned. Instead, each person takes bits of information learned and applies them to their own life's circumstances as necessary. Since there is insufficient time to allow for application of all learning, learners should be provided the opportunity to select what is interesting to them. Doing so will enable the learning experience to become much more meaningful and may even inspire them to explore further.

7.2.3 Only Teach What *Needs* To Be Taught

As an instructional designer, it is easy to get caught in the habit of trying to teach everything, forgetting to consider what prior knowledge new learners may or may not have. Too much information is not good. Forcing demanding amounts of content into learners leaves them feeling lost and frustrated. Imagine if videogames forced the player to read textbook-sized instructional manuals before letting new players begin. The gaming industry would not be where it is today if this were the case.

Instead, it is important that educators only teach what needs to be taught. Yes, there is always more that can be learned, but leave that up to the learner to discover for him/herself. Allow learners to be provoked to discover and ask questions. Doing so will provoke in learners a greater sense of reward since they will feel like they are on a quest for knowledge, with each answer leading them closer to mastery. In-game training systems within videogames enable this type of learning. As the learner explores new areas, the training system provides answers to the questions that are inevitably stirring up in their head.

7.3 Summary

Although videogames have, for years, utilized built-in training systems to teach their players, the effect of these systems has remained largely unknown. As games become increasingly more complex, we are seeing more and more implementation of sophisticated context-sensitive in-game training systems that teach the player during play. We set out to test this approach and our results revealed to us that training during play is clearly the approach worth taking – doing so before play yields no benefit.

Players want to play. Recognizing this fact and designing with this in mind will help you to create a training system that works. In-game training should not intrude on the experience of play, it should enhance the experience by enabling players to perform better and by immersing them into a deepened state of flow.

8 CONCLUSION

This thesis describes a methodology for developing training systems within games that can improve player performance. It became clear during our studies with *Symptom Shock* and *Heads Up Hockey* that before learning the content embedded within educational games, it is necessary that the player understands how to play the game itself. My exploratory research on in-game training systems within videogames allowed me to establish a design approach that game designers can follow for the development of in-game training systems that teach the player how to play. The research also revealed some of the advantages to in-play training. With the hypothesis that in-play training would yield better results in player performance and enjoyment, I created an in-game training system and tested it against a before-play training group and a control group.

The results of the study support the proposition that in-play training is an effective method for teaching the player how to play, as measured by increased player performance. An equally telling performance finding was that before-game training yielded no benefit. When player enjoyment was measured, there were no significant differences among the three groups tested. In-play training therefore provided a training approach that increased the player's ability to learn the game without jeopardizing the fun and excitement of the experience.

8.1 Considerations for Future Research

In Chapter 7, I describe some hypothetical training systems for games of other genres. Genre is important to consider when developing training systems since game genres have distinct differences that alter the form of user interaction. Nonetheless, I believe that in-play training may provide significant benefit over before-play training across a variety of genres. The research with *Heads Up Hockey* shows that during-play training can be made to work with sports games. Qualitative research should be performed on games of other genres to determine whether during-play is the optimal solution for all games

My study was focused primarily on the influence of the time of learning. There remain other significant questions to be addressed concerning the effectiveness of varying types of training. Due to a variety of constraints, the system developed for *Heads Up Hockey* used simple text and images to portray the instructional information. While this approach worked, it is possible that a different approach could have yielded a greater improvement in performance and player enjoyment. The time of training is only one aspect of the problem, and there is a need for further research on the design of in-game training.

8.2 Practical Implications

In this final section, I would like to present some of the practical implications of this research. Until now, game developers had to rely on their own observation of the successes and failures of other videogame training systems when determining which approach to training is the most effective. My research indicates that game developers can design their training systems with confidence in the value of in-play training. This research also illustrates that the application of in-play training systems can be refined through the ongoing evaluation of player performance. This will allow the game system to offer supplementary training at the time it is needed.

In Chapter 4, I describe my efforts to develop a database focused on the training systems used in commercial games. My efforts resulted in the documentation of nearly fifty games, most of them from the sports genre. The value of a more sophisticated database with searching features, image attachments, and user-defined queries would be significant. I believe that a more comprehensive database could have a significant impact on the way game designers approach training in the future. Up until now, game designers have had to rely merely on their own experiences and ideas. A fully developed database would provide developers with a wealth of examples that could be assessed and evaluated prior to developing their own training system. This would save them time, money, and would ultimately improve their games.

Finally, the results from this research provide further evidence that *situated learning* is an ideal approach to teaching. When there is context for the learning, there is meaning. Situated learning enables the learner to more easily understand why they are learning something, and this can positively influence learning in both the short-term and the long-term. This is as useful for the game designer as it is for educational designers. Though games exist at varying levels of complexity, they all require that the player understand how to play them. Successful in-game training is a significant support for the development of games that are challenging, rewarding, and void of frustration.

APPENDICES

Appendix A: Adjustments to the Flow State Scale questionnaire

Question	Original Wording	Adjusted Wording	Rationale
13	I was aware of how well I was performing.	I was aware of how well I was playing.	In all instances, the word "performance" was replaced with "playing" to reflect the nature of the experience.
16	I was not worried about my performance during the event.	I was not worried about my performance during the game.	"Event" was replaced with "game" to focus the question more closely to the experience.
18	I loved the feeling of that performance and want to capture it again.	I loved the feeling of that play time and want to feel like that again.	The concept of "capturing a feeling" was deemed difficult to understand and was modified.
19	I felt I was competent enough to meet the high demands of the situation.	I felt I was skilled enough to meet the high demands of the situation.	"Competent" was deemed as difficult vocabulary and was consequently replaced with "skilled".
20	I performed automatically.	I did things automatically.	Since the players weren't performing, the wording was changed slightly.
25	I was not concerned with how I was presenting myself.	I was not concerned with how I may have been acting while I was playing.	Wording was modified to suit the video game playing experience.
31	I could tell by the way I was performing how well I was doing.	I could tell by the way I was playing how well I was doing.	Refer to question 13.
33	I felt in total control of my body.	I felt in total control of the controller.	While playing, players physically manipulate a controller and the working change reflects this.

Appendix B: Pseudo code for *Heads Up Hockey*'s intelligent in-play training system

The pseudo code below was written prior to the implementation of the actual in-play training system. This code was used as a basis upon which to code the training system. Once the initial implementation was in place, further iterations occurred and the final code became slightly different than what is described below.

Level 1: Player has had no instruction
Level 2: Player has seen instruction, might not fully understand or apply it
Level 3: Player has applied instruction

Line Changes

Variable Definitions

- lineEnergy = the energy of a line (0-100)
- timer.lineChange = timer to measure time between line changes
- lineChange = a flag that is true when line is changed
- lineChanged = total number of line changes

Level 1

- If (lineEnergy(anyline) < 80) then (prompt "To keep your team healthy and fresh, frequently change your lines (6 and 8). Well rested players not only play better, they are also less prone to injury."): Goto Level 2

Level 2

- If (lineEnergy(anyline) < 80) then (startTimer(lineChange))
- If (lineChange) then (timer.lineChange = 0: lineChanged++)
- If (timer.lineChange == 60) then (prompt: timer.lineChange = 0: lineChanged = 0)
- If (lineEnergy(anyline) > 80) then (stopTimer(lineChange): timer.lineChange = 0)
- If (lineChanged == 8) then (Goto Level 3)

Injuries

Variable Definitions

- injury = a flag that is true when an injury occurs
- timer.injuryDelay = a timer that checks the time that has occurred since an injury
- ui.showEditorHelp = a flag for the UI to display line editor help
- injuredRemoved = a flag that is true when injured player is taken from the lineup
- injuredRemovedTot = total consecutive successfully removed injured players

Level 1

- If (injury) then (prompt "When a player is injured, a Red Cross will appear over his head. Pause (10) the game and use the line editor to remove the player from play.": startTimer(injuryDelay): ui.showEditorHelp = true: goto Level 2)

Level 2

- If (injuryDelay == 10) then (prompt: injuryDelay = 0: injuredRemovedTot = 0)
- If (injuredRemoved) then (stopTimer(injuryDelay): injuredRemovedTot++)
- If (injuredRemovedTot == 2) then (goto Level 3)

Checking

Variable Definitions

- playerHasPuck = checked on a change in position; true if player is in control of the puck
- timer.awayHasPuck = a timer to indicate the time that the player has NOT controlled the puck

- playerCheckedTot = the total possession changes wherein the player has taken the puck

Level 1

- If (!playerHasPuck) then (startTimer(awayHasPuck)) else (stopTimer(awayHasPuck): timer.awayHasPuck = 0)
- If (timer.awayHasPuck == 8) then (prompt "To get the puck from another player, skate into them (11) to check them. Be careful though, skating too fast into another player is dangerous.": timer.awayHasPuck = 0: goto Level 2)

Level 2

- If (!playerHasPuck) then (startTimer(awayHasPuck)) else (stopTimer(awayHasPuck): timer.awayHasPuck = 0: playerCheckedTot++)
- If (timer.awayHasPuck == 15) then (prompt: playerCheckedTot = 0)
- If (playerCheckedTot == 8) then (goto Level 3)

Shooting

Variable Definitions

- attackZone = indicates current attack zone (home/away)
- timer.shootDelay = a timer to indicate time in attack zone without a shot
- shot = a flag that is true when a player takes a shot
- shotTot = the total shots taken without a prompt
- didNotShoot = total times that the player was in the attack zone and did not shoot

Level 1

- If (attackZone == "home") then (startTimer(shootDelay)) else (stopTimer(shootDelay): timer.shootDelay = 0)
- If (shot) then (timer.shootDelay = 0)
- If (timer.shootDelay == 3) then (prompt "To take a slap shot, hold down the shoot button (1). To perform a wrist shot, very quickly tap the shoot button (1).": timer.shootDelay = 0: goto Level 2)

Level 2

- If (attackZone == "home") then (startTimer(shootDelay)) else (stopTimer(shootDelay): timer.shootDelay = 0)
- If (shot) then (timer.shootDelay = 0): shotTot++)
- If (timer.shootDelay == 5) then (didNotShoot++: timer.shootDelay = 0: If (didNotShoot == 3) then (prompt: didNotShoot = 0: shotTot = 0)):
- If (shotTot == 6) then (goto Level 3)

One-Timer

Variable Definitions

- timer.onetimerDelay = timer to indicate time elapsed since last one-timer attempt
- onetimer = a flag that is true when a player attempts a one-timer
- onetimerTot = the total one-timer attempts without a prompt

Level 1

- startTimer(onetimerDelay)
- If (onetimer) then (timer.onetimerDelay = 0)
- If (timer.onetimerDelay == 45) then (prompt "Pass (2) to an open player, then quickly tap and release the shoot button (1) to execute a one-timer.": timer.onetimerDelay = 0: goto Level 2)

Level 2

- If (onetimer) then (timer.onetimerDelay = 0: onetimerTot++)
- If (timer.onetimerDelay == 90) then (prompt: timer.onetimerDelay = 0: onetimerTot = 0)
- If (onetimerTot == 3) then (stopTimer(onetimerDelay): goto Level 3)

Speed Burst

Variable Definitions

- timer.speedburstDelay = timer to indicate time elapsed since speed burst has been used
- speedburst = a flag that is true when a player uses speed burst
- speedburstTot = the total times speed burst has been used without a prompt

Level 1

- startTimer(speedburstDelay)
- If (speedburst) then (timer.speedburstDelay = 0)
- If (timer.speedburstDelay == 30) then (prompt "Tapping the Speed Burst button (1) when you are not in control of the puck will give your player an extra burst of speed. Be careful though, speed bursts require extra energy and can cause painful collisions with other players.": timer.speedburstDelay = 0: goto Level 2)

Level 2

- If (speedburst) then (timer.speedburst = 0: speedburstTot++)
- If (timer.speedburstDelay == 45) then (prompt: timer.speedburstDelay = 0: speedburstTot = 0)
- If (speedburstTot == 25) then (stopTimer(speedburstDelay): goto Level 3)

Appendix C: Screenshots of the games database

ID	Game Name	Developer	Publisher	Year R	Genre	Trainin	Learn	Difficulty	Rating	Print	On-Scre	Input Inte	Help Av
1	Grand Theft Auto: San Anc	Rockstar Nort	Rockstar G	2004	Action	60	1	Medium	95.4	☑	☑	☐	☐
3	Gran Turismo 4	Polyphony Dig	SCEA	2005	Driving	300	1	Medium	91.5	☑	☑	☐	☐
4	Auto Modellista	Capcom	Capcom	2003	Driving	0	0.5	Easy	66.3	☑	☑	☐	☐
5	Frequency	Harmonix	SCEA	2001	Music	15	0.5	Variable	84.3	☑	☑	☑	☐
6	Amplitude	Harmonix	SCEA	2003	Music	20	1	Medium	85.7	☑	☑	☑	☐
7	NHL 2K3	Treyarch	Sega	2002	Sports	0	0.5	Variable	85.7	☑	☐	☐	☐
8	NHL 2004	EA Sports	EA Sports	2003	Sports	45	2	Variable	84.4	☑	☐	☑	☐
9	NHL 2005	EA Sports	EA Sports	2004	Sports	45	1	Variable	77.1	☑	☐	☑	☐
10	NHL 2K5	Kush Games	Sega	2004	Sports	45	1	Variable	85.6	☑	☑	☑	☐
11	Star Ocean: Till the End of	Tri-Ace	Square Enix	2004	RPG	0	0.5	Medium	82.5	☑	☐	☐	☐
12	SSX	EA Sports Big	EA Sports E	2000	Sports	5	1	Hard	91.9	☑	☐	☑	☑
13	SSX Tricky	EA Sports Big	EA Sports E	2001	Sports	30	0.5	Variable	92	☑	☐	☑	☐
14	SSX 3	EA Sports Big	EA Sports E	2003	Sports	0	0.5	Medium	92.4	☑	☑	☐	☐
15	Ace Combat 04	Namco	Namco	2001	Simula	30	0.5	Medium	84.9	☑	☑	☑	☐
16	Burnout 3: Takedown	Criterion Gam	EA Games	2004	Driving	10	0.5	Medium	93.3	☑	☑	☐	☐
17	Katamari Damacy	Namco	Namco	2004	Puzzle	20	0.25	Medium	86.2	☑	☑	☑	☐
18	NBA Street Vol. 2	Electronic Art	Electronic A	2003	Sports	30	0.5	Medium	89.6	☑	☑	☐	☐
19	Kingdom Hearts	Square Enix	Square Enix	2002	RPG	30	0.5	Medium	86.9	☑	☑	☐	☐
20	Prince of Persia: The Sand	Ubisoft	Ubisoft	2003	Action	45	0.25	Easy	92.1	☑	☑	☐	☐
21	Ico	SCEA	SCEA	2001	Adventi	0	0.25	Medium	90.7	☑	☐	☐	☐
22	Themepark Roller Coaster	Bullfrog Produ	Electronic A	2000	Simula	60	0.25	Easy	82.6	☑	☑	☐	☑
23	Midnight Club: Street Racii	Rockstar San	Rockstar G	2000	Driving	0	0.5	Medium	76.9	☑	☑	☐	☐
24	Grand Theft Auto III	Rockstar Nort	Rockstar G	2001	Action	60	1.5	Hard	94.8	☑	☑	☐	☐
25	Devil May Cry	Capcom	Capcom	2001	Action	15	0.25	Hard	92.5	☑	☑	☐	☐
26	Metal Gear Solid 2	KCEJ	Konami	2001	Adventi	30	0.5	Medium	95.5	☑	☑	☐	☑
27	Socom II: U.S. Navy Seals	Zipper Interact	SCEA	2003	Action	60	1	Medium	87.7	☑	☑	☐	☐
28	Wave Race: Blue Storm	Nintendo	Nintendo	2001	Driving	30	1	Variable	82	☑	☐	☑	☑
29	TransWorld Surf: Next Wa	Rockstar San	Atari	2003	Sports	5	1	Medium	65.8	☑	☐	☑	☐
30	NBA Live 2004	EA Sports	EA Sports	2003	Sports	10	0.5	Variable	80.3	☑	☐	☑	☐
31	Viewtiful Joe	Capcom	Capcom	2003	Action	15	0.5	Medium	92.2	☑	☑	☐	☐
32	NHL '94	EA Sports	EA Victor	1993	Sports	0		Medium	70	☑	☐	☐	☐
33	NHL '95	Visual Concep	EA Sports	1995	Sports	0		Medium	70	☑	☐	☐	☐
34	NHL '96	Tiburon Entert	EA Sports	1995	Sports	0		Medium	70	☑	☐	☐	☐
35	NHL '98	Electronic Art	EA Sports	1997	Sports	15			70	☑	☑	☐	☐

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ID	Game Name	Developer	Publisher
18	NBA Street Vol. 2	Electronic Arts	Electronic Arts

Year Released	Genre	Training Time (minutes)
2003	Sports	30

Learning Curve (GameSpot)	Difficulty
0.5	Medium

Print	On-Scrn Txt	Help Avatar	Video	Tutorial	Voice-over	Context-se	Learning Content
☑	☑	☐	☐	☑	☑	☑	Interface Mastery

Platform	Players	Hardware Interface
PS2	Single/Multi Player	Controller

Comments

Built right into NBA Street Vol. 2 is a mode called "Street School". This mode is hosted by a character named "Stretch Monroe" who basically gives pep-talks to keep you motivated. In the school, there are 26 different moves that need to be completed. They are done in an in-game situation, but the interaction is setup to support the move. Before entering the play scenario, some text explains what the player is to do. When the player begins playing and moves into position, some instruction will appear on the screen identifying what buttons need to be pressed to execute the move. After completing all 26 moves, the player is rewarded with some points and a character jersey. Throughout the training, anytime a tricky concept such as 'gamebreaker' or 'turbo' comes into effect, a screen will come up explaining how it works.

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