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Thomas Satwicz

Technology at Play: An Ethnographic Study of Young People's Video Gaming Practices

Thomas Satwicz

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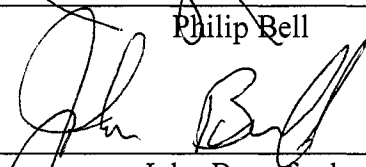


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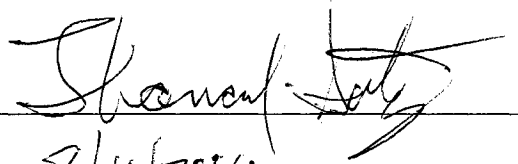


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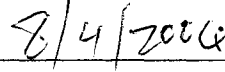
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Abstract

Technology at Play: An Ethnographic Study of Young People's Video Gaming Practices

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Chair of the Supervisory Committee
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This study is a close ethnographic analysis of a small number of children's video gaming practices. The gamer, as the unit of analysis, was followed as competencies in the game context developed over several months. Throughout the study the question was asked: What are gamers learning as they play? The study seeks to extend everyday cognition and informal learning research into an aspect of children's lives we know little about. This in turn helps us understand how children shape their own activities and interactions towards self-directed learning. The analysis is based on an ecological or distributed perspective of cognition and learning. Video recordings of in-home game playing, field-notes, interviews with children and parents about their game playing, and a collection of resources children use in their activities are used to understand how children engage in this learning process. Findings from this study are then used to develop design recommendations for learning environments.

TABLE OF CONTENTS

	Page
List of Figures	ii
List of Tables	iii
Introduction.....	1
Chapter I: Young People’s Relationships with Games.	10
Chapter II: Making and Breaking Routines.....	38
Chapter III: Playing with Representations: How Do Kids Make Use of Quantitative Representations in Video Games?.....	95
Chapter IV: Games as Adaptable Resources: Educational Design Recommendations Based on an Ethnographic Analysis of Young People’s Video Gaming Practices.....	142
Epilogue.....	164
References.....	167
Appendix I: Sample Content Log.....	173
Appendix II: Participant Screening Questions.....	178

LIST OF FIGURES

Figure Number	Page
0.1 Sample screen shot	6
2.1 Katarina first notices the no workers low food snag	47
2.2 Image of Pharaoh shown during exit interview (img17)	53
2.3 Image from <i>The Ultimate Spiderman</i> of goals	59
2.4 Table from <i>Final Fantasy X-2</i> strategy guide	60
2.5 Beginning of a battle sequence in <i>Final Fantasy X-2</i>	62
2.6 End of a battle sequence in <i>Final Fantasy X-2</i>	62
2.7 Vanessa's <i>Final Fantasy X-2</i> strategies	65
2.8 Event mode list in <i>Super Smash Brothers Melee</i>	74
2.10 The menu screen in <i>Super Smash Brothers Melee</i>	88
3.1 Quantity representations in video games	100
3.2 A sketch of the distributed game system	105
3.3 A screen shot of a typical battle in <i>Super Smash Brothers Melee</i>	106
3.4 A graph of battle attempts in <i>Super Smash Brothers Melee</i>	108
3.5 Johnny's marking of quantitative information in <i>Super Smash Brothers Melee</i>	116
3.6 Written annotation leading up to Figure 3.3	117
3.7 Battle scene in <i>Final Fantasy X-2</i>	122
3.8 Raising character's HP after battle in <i>Final Fantasy X-2</i>	125
3.9 Changing dresspheres in <i>Final Fantasy X-2</i>	130
3.10 A two--node garment grid in <i>Final Fantasy X-2</i>	133
3.11 Sphere Break in <i>Final Fantasy X-2</i>	136
4.1 A representation of how the non-school game is structured	153
4.2 How the design recommendations are implemented	155

LIST OF TABLES

Table Number	Page
2.1 Repeated action sequence during <i>Super Smash Brothers Melee</i>	71
3.1 Commands during a simple battle sequence in <i>Final Fantasy X-2</i>	123
3.2 Commands during a challenging battle sequence in <i>Final Fantasy X-2</i>	128

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DEDICATION

To Barbara Jean Satwicz (1956 - 2006)
who never let anything get in her way.

Introduction

In both popular media and academic writing video games, as a pervasive aspect of young people's everyday activities, are represented in divergent ways. On the one hand they are portrayed as problematic indulgent activities (Malkin, 1999; Anderson, 2002). On the other, they are celebrated as "a new medium" (Grossman, 2004), "a new form of art" (Gee, 2003: 204), and a new educational approach (Gee, 2003; Jenkins, 2006; Squire & Barab, 2004; Young, Schrader, & Zheng, 2006; Prensky, 2005; Dede, 2006). Despite the arguments on either side of the video game debate very little ethnographic research has been done on kids' video game play (Squire, 2002) and so neither perspective is based on substantial instances of actual game play. To make up for this missing empirical basis I closely analyze the gaming activities of a small group of children over several months in this dissertation. The gamer, as the unit of analysis, is followed as competencies develop. The study examines how the participants learned to play video games, what resources they brought to their game play, and what they took away from playing video games. The purpose of ethnographically following children's game play is to better inform concepts of what children do while playing video games that are often used in the development of educational activities. Along these lines my study concludes with five design recommendations based on my findings.

Video Games as Everyday Cognition and Problem Solving

This study fits within a larger body of work that compares formal and informal learning across settings such as school, work, and home (Bransford, Vye, Stevens et al., to appear; Heath, 2001; Stevens & Hall, 1998; Stevens, 2000a; Stevens, Wineburg,

Herrenkohl, & Bell, 2005). Studies of informal learning seek to empirically investigate the emergent instances of learning that occur through the course of everyday activities. One domain where studies of everyday cognition and informal learning have made progress towards a comparative understanding of everyday activities and formal schooling deals with the relationship between school practices and the nature of mathematical thinking. Through such studies we now understand that chronic problems create contexts for mathematical solutions that draw on cognitive, social, and material resources (de la Rocha, 1986; Lave, 1988; Saxe, 1991; Scribner, 1997). We know that accuracy is not always a product of abstraction, but due to a contextualized way of thinking (Lave, 1988). We also understand that how we see mathematical objects is socially constructed (Stevens & Hall, 1998). Not only does this work question our previous assumption that mathematics is an abstract process of the mind but it also provides grounding for further inquiries into the nature of everyday thinking.

This particular study considers the hypothesis that playing video games involves practices analogous to disciplinary activities seen at school and work (Lowrie, 2005; Sefton-Green, 2004). This hypothesis is present in arguments that game players develop skills associated with scientific and technical practices (Greenfield, Camaioni, Ercolani, et. al., 1994) and that many games are designed to emulate, to varying degrees, the disciplinary practices of politics, management, science, history, and urban planning (Squire, 2002).

The video game environment offers a context where quantitative information is represented in a variety of forms as resources for solving problems and making decisions.

I show in this study that game players' adaptive use of these representations is one aspect of how they learn to play video games. The study also explores more broadly the role video games take in the participants' lives and demonstrates how video games are adaptively used to position the player in relation to other family members and friends. I also look closely at how routine and repetitive aspects of game play are formed over time. By looking at the routines of game play I show that game players adaptively use a heterogeneous set of resources in the game and in the room where they play. This adaptive use of resources is then linked to Hutchins' (1995a) notion of learning as "adaptive reorganization in a complex system" (p. 289). The dissertation ends with the development of design principles for learning environments based on my ethnographic findings. The idea to use ethnographic findings as a basis for educational designs was advocated by Stevens (2001) as a means to move the practice of designing educational technologies forward.

Data Collection and Analysis

This study made use of the following data collection strategies: (i) Children were observed and recorded playing games and using different media in their homes through established video-based analysis strategies (Jordan & Henderson, 1995; Stevens & Hall, 1998). (ii) Children and their parents were informally interviewed throughout the observation period. (iii) At the end of the study the children participated in an exit interview where they were asked to give a "tour" of their video games and related material. The exit interview also included an artifact-based portion where participants were presented with images and corresponding videos. They were asked to annotate,

however they liked, the images and videos using a software program called *Video Traces*¹ (Stevens, in press), but were asked to answer the following three questions: (1) what is the game?, (2) what is going on in the game?, and (3) how would they determine who is going to be successful?

The analysis I present in this dissertation is taken from a larger study, Gaming to Learn What, which involved following eight children (ages 10 – 15) over a six-month period. Each participant was video recorded for one to two hours per week. The study as a whole collected over 100 hours of recorded game play. During the observation period participants were allowed to play any game they choose. By allowing the participants to select their own game the data lends itself to an analysis of the gamer and not a particular game. It also allows a better sense of how the player pursued his or her own interest and learning.

My analysis of the video data began with the creation of a content log that includes brief descriptions of the game and activity as seen on the collected recordings. Each log includes initial coding for teaching and learning moments and places where participants engaged with STEM (science, technology, engineering, and mathematics) practices. A sample content log is attached in Appendix I.

Sampling

For ethical reasons recruitment of participants began with parents. The team of researchers involved in the larger study used answers to the questions in Appendix II to

¹ *Video Traces is a computer-based medium that allows for annotation using talk, gesture, and drawing of video and still images.*

ensure participants varied across gender, ethnicity, games typically played, and whether or not the child played video games socially. As a research team we felt a variation in those categories was important for building a data set that would lead itself well to a comparative analysis common in ethnographic research on learning (Lave & Wenger, 1991; Stevens, 2000a; Stevens, 2001; Stevens, Wineburg, Herrenkohl, & Bell, 2005).

Video Analysis

The video analysis looked for comparative points (Erickson, 1986) between participants and the games they played. I took note of how the same tasks (as given by the game) differed across settings and participants (Cole, 1996). Throughout the observations several aspects of the participants' play were cataloged. These aspects include breakdowns in activity where participants encounter problems (de la Rocha, 1986; Lave, 1988), uses of quantitative information provided by the game, the implementation of outside resources—material or otherwise, and places where gamers displayed new skills or knowledge. The analysis includes a description of gaming routines, by tracking activities that remain constant across time and settings.

In each setting I recorded a minimum of two video streams. The first consisted of the game screen (“in-game”) while the second shot provided an overview of the activity in the room (“in-room”). This camera was placed next to or behind the television or monitor facing the players and captured a wide-angle shot. The two video streams were combined to provide a detailed view of the game play activity (see Figure 0.1). The purpose of creating the in-room and in-game images was an empirical attempt to move

beyond the *separate worlds* view that is present in much of the writing, academic and otherwise, on video game play (Stevens, Satwicz, McCarthy, in preparation).

A steady theme in much writing about video games is what we will call the separate worlds view of video game play. The separate worlds view holds, in different ways for different writers, that game play is a world apart of people's other activities in everyday life. Whether this separateness is framed in technocentric terms like 'immersion in virtual worlds' or in academic terms that conceptualize video games as a 'Discourse' or 'semiotic domain' (Gee, 2003; Steinkuehler, in press), we see a persistent bent that analyzes video game play as largely disconnected from the other moments and activities of people's lives (Stevens, Satwicz, McCarthy, in preparation).

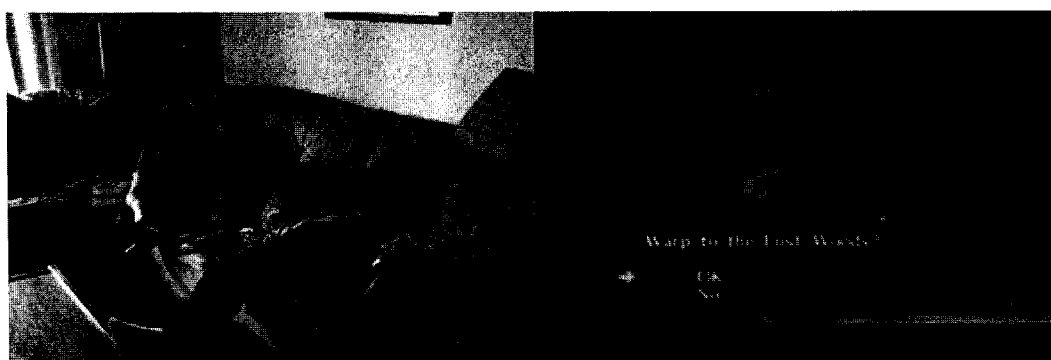


Figure 0.1: This is a sample of how my video data appears when analyzed. On the left is a video stream of the game and on the right is a recording of the participants playing the game.

Organization

The dissertation is broken into four analysis chapters. Each analysis chapter uses data from a subset of the eight participants. These four participants are the children that I followed most throughout the course of the study. I was present "in-room" when the vast majority of the data pertaining to their play was collected, although on occasion another researcher would fill in for me when I could not be present. Two of the participants, Johnny (age 13) and Mikey (age 15), are brothers who play frequently and discuss video games together, although at times they also played on their own. Vanessa (age 13), the

third participant, reported video games as a “family thing” since most members of her family played them. However, as my analysis shows, Vanessa defined her own place within the family through playing a set of video games that was different from what other members of her family played. The fourth participant, Katarina (age 12), rarely spoke of playing video games with other children or adults, with some exceptions, and would sometimes close the door to keep her brother out of the room while she played.

Chapter I: Young People’s Relationships with Games

The first analysis chapter is an inquiry into how kids learn to play video games with an analysis of their relationship with video games. A young person’s relationship with video games refers to the ways in which kids use and engage with video games in relation to other aspects of their lives. This view, that children have relationships with video games, is intended to expand upon the separate worlds notion that is present in much of the writing on video games (Stevens, Satwicz, & McCarthy, in preparation). Through an analysis of kids’ relationships with video games I am able to show that the ways in which kids position video games in their own lives has implications for what they take away from playing them. In other words, my analysis shows that the separate world of video games is present in kids’ everyday activities and that important aspects of kids’ lives seep into the play of video games. This exchange between everyday life and video games has implications for what kids take away from their play.

Chapter II: Making and Breaking Routines

In this chapter I look at the making and breaking of three routines present in my observations of game play. My analysis shows that making a routine, which I consider to

be a recurrent or repetitive activity, involves the adaptive reorganization of a variety of resources present in the game and in the room. This kind of adaptive activity is linked to concepts present in the learning sciences literature. The first is Hutchins' (1995a) definition of learning as "adaptive reorganization in a complex system" (p. 289). The second is Hatano's notion of adaptive expertise as "flexible, innovative, and creative competencies" (Hatano & Oura, 2003, p. 28). My analysis shows that the adaptive activity extends beyond what goes on inside a player's head and is distributed across the material and social environment that surrounds game play.

Chapter III: Playing with Representations: How Do Kids Make Use of Quantitative Representations in Video Games?

This chapter describes how quantitative representations present in video games are used by the participants to develop strategies and to balance what they are trying to achieve in a game with the resources they have available to them. It builds upon previous empirical and conceptual work that explores the relationship between the development of STEM concepts and practices and everyday activities (Vygotsky, 1986; diSessa, 2002; Ochs, Taylor, Rudolph & Smith, 1992; Stevens & Hall, 1998). The term quantitative practice is used to reference how people make use of quantities in their everyday activities. In the case of video games quantitative practices may exist in the form of building characters, managing virtual currency, or solving problems. The chapter concludes with the suggestion that since video games are an everyday context where quantities are used, further exploration of a relationship between video games and math class is reasonable.

*Chapter IV: Games as Adaptable Resources: Educational Design Recommendations
Based on an Ethnographic Analysis of Young People's Video Gaming Practices*

The final chapter of the dissertation contains five design recommendations based upon the findings from the previous three chapters (use of quantities, multiple modes of activity, a multidimensional narrative, bending the game, and heterogeneous set of materials). The recommendations are then used to develop a design proposal for an informal learning medium in which users explore the complexities of school. A particular use of this medium, where the task is to prepare a character to enter a STEM discipline, is drawn out.

Chapter I: Young People's Relationships with Video Game

I will begin my inquiry into how kids learn to play video games with an analysis of their relationship with video games. My intention is to show that the ways in which kids position video games in their own lives has implications for what they take away from playing them. My analysis makes use of the idea that kids do in fact have a relationship with video games. By relationship I am referring to the ways in which kids use and engage with video games in relation to other aspects of their lives. This perspective on video games, that children have relationships with them, is an expansion of the separate worlds view that is present in much of the empirical and conceptual work on video games (Stevens, Satwicz, & McCarthy, in preparation). The separate worlds view is one that sees video games as apart from other aspects of life. In this light games are often characterized as 'immersive virtual worlds' or 'semiotic domains' (Gee, 2003; Steinkuehler, in press). Here I will show that the separate world of video games seeps into kids everyday activities and that kids lives find their way into the video games. This exchange between everyday life and video games has implications for what kids take away from their play.

Games are fun

Despite arguments made on either side of the video game debate, none of the participants in this study said they use video games as bridges to disciplinary practices, as a "cognitive workout", or as a training mechanism for aggressive behavior. When asked by a research team member why they play video games our participants generally focused on games as a source of entertainment. Mikey (M) and Johnny's (J) first responses (see Segment 1.1) were that video games are fun.

Segment 1.1

M: it's really fun=

J: =it's fun

T: what do you mean by that, 'fun'?

M: it's entertaining, it's ah=

J: =it doesn't rain.

T: it doesn't rain (laughs).

M: ah, let's see. Main reason for playing video games. I don't know. It'd be like, why does someone play baseball? Cause they just grew up loving it and I guess that's sort of what we do with video games, we just sort of grew up liking video games. Cause our friends all had them and then we finally got 'em. Then we really liked them I guess. uh. alright

Katarina (K) had a similar response to the same question citing the entertainment value of video games (Segment 1.2).

Segment 1.2

K: Cause it's entertaining and it's like, trying to solve things and.

T: ok=

K: =I don't know it's kind of addicting and just you don't really think about why you're doing that.

T: unhun, what would you say is entertaining about it?

K: Like that you're doing something- I like games that it's not like everyday life. Which is most games aren't everyday life. So that's like. Cause it's like different from kind of life I guess cause it's not like something you do so it's like 'oh cool I can do this in the video game' I'd be like, 'go kill a big elf or something'

T: mmhum

K: And you can't really do that. It's just you don't really get to do it in real life I guess.

T: mmhum

K: plus it's entertaining

Vanessa (V) had a similar answer as well.

Segment 1.3

V: fun and whenever I'm bored I just do it.

T: whenever you're bored?

V: and my dad taught me how to play.

T: ok, what do you find fun about it?

V: um, sometimes depending on what it is, Kingdom Hearts I like the story line and um Tekken I like the story line or the graphics look kind of cool or I may see it on TV and that looks kind of cool.

[Vanessa 2006-02-16_00:07:40.01]

In analyzing the complexities of video game play it is easy to leave behind the entertainment value games have for our participants (and likely other children as well). My intention in bringing this aspect of game play in at an early stage of the analysis is to begin to situate where our participants might place video games in relation to other activities in which they are involved. Certainly for our participants video games are a leisure activity, which is part of what places their play within the informal learning category.

In this chapter I will describe three of our participants relationships with games. I have selected these three participants because they are the focus of the majority of this dissertation, they are the participants that I have followed the closest throughout the broader project, and the ways in which they use video games differ in some analytically useful ways. Each of the three cases is organized around a different participant—Mikey (age 15), Katarina (age 12), or Vanessa (age 13).

Mikey: A career player, a critic, a knowledge resource, a broker, and a collector

Based on conversations I have had with Mikey and my observations I have identified five different dimensions to characterize Mikey's relationship with games. On the one hand I see him as a *career player* that participates in a gaming world. I use "career" to describe his player status because of how he characterized his play of video games as a life long activity in Segment 1.1; "we just sort of grew up liking video games". I also see him as a *critic* of video games because of how he categorized particular games and game systems throughout the study. Mikey also identified himself as a kind of *knowledge resource* and acts as a *broker* to the gaming community for his

siblings and friends. Finally I see him as a *collector* for his intentional accumulation of video games, game systems, and other resources.

Mikey as a career player

The “main reason” Mikey gave for playing video games, when he was asked in Statement 1, makes reference to having grown up playing video games. In his response to my question, he drew an analogy to why another hypothetical person might play baseball because “they just grew up loving it.” This statement is striking because it indicates a long-term relationship with video games that extends beyond an immediate entertainment value we might take from the previous part of his statement; “it’s really fun.” This aspect of his relationship with video games also indicates that experiences with different video games are not isolated, that they are connected over time. Video games are not just something he does; they are something he has grown up with, suggesting that they contribute to his development.

Mikey as a game critic

My observations of Mikey’s play indicate that for a video game to be entertaining it must fit within some constraints. His recognition of these constraints within games leads me to characterize him as a game critic. In this light his activities take a proto-disciplinary form (Stevens, 2000; O’Connor, 1998) in that he is acting in an early form of a role people play professionally. For instance on one occasion he played a multiplayer role-playing game called Tales of Symphonia with his brother Johnny for 35 minutes. After spending five or six minutes in a part of the game that involved reading dialogue between characters on the screen their characters died before they could save the game.

Mikey then broke off play of this game declaring that he did not want to have to go through that portion of the game again (see Segment 1.4, lines 2-4).

Segment 1.4

1. (Johnny and Mikey's characters in Tales of Symphonia have just died and the game is over.)
2. M: I don't want to play this game anymore.
3. J: What are we supposed to play?
4. M: I don't know. After doing all that, I don't want to listen to all those people again.
5. J: Excuse me (to his dog sitting on his lap, he gets up to switch video games).
6. M: I don't want to ever hear from them again. At least I don't want to play it today cause oye,=
7. J: =That was crazy= (referring to something going on with the game console)
8. M: =if I have to listen to those guys again, that was really boring. Looks like this really is one of those games
9. J: (inaudible as he changes the game)
10. M: looks like this is really one of those games where you have to level up infinitely.
11. T: What do you mean by that?
12. M: Where you have to do a bunch of fighting, pointlessly for hours on end just to get stronger.

[Johnny and Mikey 2005-11-17_00:50:53.19]

Given Mikey has displayed an emphatic engagement with the Harry Potter book series I do not see this moment as unwillingness to engage with traditional forms of literacy. I do however think Mikey is judging the quality of play in the game and then determining whether continuing to play it is a good use of his time. Mikey often refers to this aspect of games as “gameplay¹”. In Segment 1.4 (lines 10 – 12) he speculates that in Tales of Symphonia they will have to level up, an activity he describes as pointless. On another

¹ “Gameplay includes all player experiences during the interaction with game systems, especially formal games. Proper use is coupled with reference to ‘what the player does’” (Wikipedia, 2006, Gameplay). This should not be confused with “game play” (two words), which refers to the activities that surround the playing of video games.

occasion when discussing one of his favorite games, *Kingdom Hearts*, he described leveling up in that game as “really fun” because “it’s more action based.” I take Mikey’s judgment of gameplay as one way that he forms critiques of video games, as Segment 1.4 also indicates he uses this as a means to determine which games he wants to play.

Mikey also judges the game systems (e.g. Nintendo Game Cube, Playstation 2, Nintendo 46, etc). In the exit interview he and Johnny showed me several game systems they had stored in the basement. Although some of the game systems were released over ten years ago they were played during my field visits. The Nintendo-64 (N-64) was released in September of 1996, nine years prior to this interview yet, as Mikey says, his friends still use it and he thinks it is “the best system ever” (see Segment 1.5, line 2). Given the fast progression of gaming technology this is potentially significant because it speaks to his ability to evaluate video games beyond what is new and exciting. His reason for why it is the best game system ever also points to how video games are connected to other aspects of his life, “it was just so simple that anyone could play it” (see Segment 1.5 line 6). Mikey here is referencing play as an activity he does with other people, his friends, not in isolation.

Segment 1.5

1. T: So do your friends still play the N-64 a lot?
2. M: yeah, even though it kind of burns your eyes it's really really the best system ever.
3. T: Really? Why is that?
4. M: It came out- they always had the best games=
5. J: =it was the first system with all the platforms=
6. M: =and it was just so simple that anyone could play it

[Johnny and Mikey exit-interview_00:01:15.05]

Mikey as a knowledge resource

Mikey's relationship with games contains a dimension that positions him as a knowledge resource to others. One other thing Mikey showed me during the exit interview was a collection of *Nintendo Power* magazines (see Segment 1.6, lines 1 – 11). Mikey reported that although these magazines are several years old the information in them is valuable (see Segment 1.6, line 13). As indicated by Segment 1.6 (line 15), when Mikey referenced a potential future play of the game *Beautiful Joe*, the value in the magazines is that they may be useful during future play. Segment 1.6 (line 15) also indicates that the informational value is not limited to Mikey's own play. Mikey contends that friends come to him with "questions about gaming" because his collection of magazines provides him with a guide for any game. In other words, Mikey has a relationship with games where he can be a knowledge resource to others, by providing a guide, without having ever played the game.

Segment 1.6

1. M: and then you said you wanted magazines too.
2. T: sure
3. M: This isn't the full thing but I got about um like forty of these (laughs) in my room ((pulls out a stack of about 10 magazines))
4. J: Mikey you've got more than forty.
5. M: No I've got only about forty.
6. T: Which magazine is it?
7. M: This is Nintendo Power.
8. T: Is that the only one you get or are there others=
9. M: =yeah, uh actually we got a free bonus for buying something once. EGM and
10. J: =I've got fifteen Game Informers=
11. M: =Game Informers. So we've got Nintendo Power
12. T: And do you keep em? Or do you ever=
13. M: Yeah I always keep my Nintendo Powers because if you keep them they have spine art and if anybody ever has a question about gaming they always come to me because I have a guide for any game you ask.
14. J: And plus if you want to buy an old game but you don't know which to buy you could see the ratings in Nintendo Power (O: yeah) from when they first came out.
15. M: Like for instance, ((flips through one of the Nintendo Powers)) uh. This one, this is when Beautiful Joe, the first one ever came out. (T: mmhum) People get stuck on that ((slams the magazine shut)) we have a guide for it.

[Mikey and Johnny exit-interview_00:02:27.07]

Mikey's knowledge of the gaming world also includes the history of particular video game characters. For instance, during one field visit (2005-07-14) Mikey's siblings used him twice as a resource on the history of the Nintendo characters Mario and Donkey Kong and once as a source on older Nintendo game system. In all of those instances he spoke of video games or game systems that were released and popular before he was born.

Mikey as a broker

Another dimension to Mikey's relationship with games can be characterized by his introduction of the gaming world to his younger sister Maddy. When Mikey's family

first contacted us about participating in the study they described their game play as primarily social and including all of the children in the family. I found over time that they did play together, although most often the boys played on their own. On occasion their younger sister Maddy was brought into their activities. The process of getting her involved in the game play was often not as straightforward as one might expect. First, in only two of the nineteen games I watched the boys play did she directly control a character in the game, however she would often sit in the room and comment on the activity in the game. When she did play a controller would have to be brought up from the basement and there was a definite pause in the action. On one occasion Mikey switched games specifically so Maddy could play with him. At times, when the boys played without her, Maddy would sit behind them and play with other toys or an older portable *Gameboy*.

An example of Mikey acting as a knowledgeable oldtimer for Maddy who is a newcomer to the gaming world is transcribed in Segments 1.7 and 1.8. The two instances, which took place within minutes of each other, show Mikey providing assistance to Maddy as she requests it. Additionally, the positioning of their bodies in relation to the television screen forms a kind of inner and outer circle of play. On the inside, Johnny and Mikey sit close to the screen and play their own game. On the outskirts, Maddy watches them play and also has her own portable game system in hand. Occasionally Maddy will move up into the inner circle and play with Johnny and Mikey the game on the television screen. Segment 1.7 begins when Maddy slid off her chair towards the inner circle and asked Mikey for help with her Barbie game (see Segment 1.7, lines 1 and 2). Mikey suggested that she should not play that game because it involved matching colors and the

screen would not show the colors (newer *Gameboys* have color screens), but Maddy did not accept his explanation (see Segment 1.7, lines 3-12). In the end (Segment 1.7, lines 13 and 14) Maddy left the room and declared that she would “try it anyway.” This is an instance where Mikey attempted to guide his younger sister while she encountered some technical aspects of the gaming world. It shows how Mikey not only acts as a knowledge resource, but also acts as a broker by introducing his younger sister to the gaming world.

Segment 1.7

1. Ma: Mikey (inaudible) my Barbie game on this now.
2. ((Slides off chair in the back of the room toward Mikey who is sitting on the floor in front of the TV playing a video game with Johnny.))
3. Mi: You really don't want Maddy, you'll lose on every game because all of the games are color coded.
4. Ma: (inaudible) color=
5. Mi: Maddy you'll lose on every game cause when you've got to do a puzzle or you've gotta=
6. Ma: I don't do puzzles.
7. Mi: OK what do you do?
8. J: Mikey look at my little PK thunder ((referring to the video game on the TV which is now paused.))
9. Mi: woah
10. Ma: I do:: shirts, I do:: lipstick=
11. Mi: =right oh Maddy you'd never be able to tell especially with the lipstick. Cause they are all colors Maddy.
12. Ma: It's really hard on the lipstick now because I've gotten far.
13. ((As Maddy walks out of the room. Mikey and Johnny continuing playing the game on the TV. Maddy comes back to into the room 18 seconds later.))
14. Ma: I'm just going to try it anyway.

[Johnny and Mikey 2005-09-16_00:27:38.04]

In Segment 1.7, Mikey told Maddy, after she asked for his help, that she really did not want to play her Barbie game on the non-color system she had because she would lose. Maddy openly rejected this advice several times and eventually left the room declaring she would play it anyway. In Segment 1.8, which took place four minutes after

Segment 1.7, Maddy again looked to Mikey for help in setting up the game (see Segment 1.8 line 2). After a bit a disagreement about the problem Maddy was having (see Segment 1.8 lines 3-8), Mikey took the game system from her (see Segment 1.8 line 11). Notice that the game system, not Maddy, entered the inner circle. Mikey then got the game started for Maddy and then passed it back to her (see Segment 1.8 line 15-17). He then continued playing his game with their brother Johnny. Taken together, Segments 1.7 and 1.8 show how Mikey introduces the gaming world to his younger sister Maddy. He acts as a more experienced gamer that she can go to for assistance when needed. On other occasions he adjusts his play and involves her in his games.

Segment 1.8

1. ((Maddy is sitting on a chair in the back of the room facing the TV. Mikey and Johnny are in front of Maddy also facing the TV playing a game.))
2. Ma: Mikey how come it's not starting my game?
3. Mi: What do you mean it's not starting your game?
4. Ma: I'm pressing 'b' but it won't go to the game?
5. Mi: Why are you pressing 'b'?
6. Ma: It says, "press b to continue your game."
7. Mi: No, it says "press start to continue your game."
8. Ma: No, it says "press start to begin a new game."
9. ((Game on TV is paused and Mikey turns around to look at Maddy.))
10. Mi: Are you crying?
11. ((Mikey reaches his hand out and Maddy passes him the Gameboy.))
12. Ma: No.
13. Mi: It sure sounded like it.
14. J: yeah (quietly)
15. ((Mikey looks at the Gameboy and pushes a few buttons.))
16. Mi: You got your code wrong then, let me see it.
17. ((Mikey reaches his hand out and takes a piece of paper from Maddy. He then reenters the code showing Maddy what parts she has entered wrong, passes the game back to Maddy, and continues playing the game on the TV with Johnny.))

[Johnny and Mikey 2005-09-16_00:33:09.11]

Mikey as a game collector

The final dimension I use to understand Mikey's relationship with video games is that of a *collector*. This is most easily seen in his description of a trip to Germany and the collection of game systems, video games, and magazines in the family's basement. While on a youth group trip to Germany Mikey purchased a Pokémon video game for his *Gameboy*. When he and I discussed his trip (see Segment 1.9) and the game he purchased he spoke of how much video games cost in Munich (see Segment 1.9 line 1) and how their cost limited the games that he could actually purchase (see Segment 1.9 line 9). His mention of the economics that surrounds video games indicates that he attends to aspects of the game not present in the immediate context where they are played. Mikey is cueing off of information on video games that he picked up in two different countries in situations where games are sold and not primarily played. This indicates that his relationship with video games extends beyond the walls of his house to places where he can find and gather them.

Segment 1.9

1. M: Munich has everything but cheap video games. The video games over there are really expensive, I think that is the problem with their economy (laughs).
2. T: That video games are too expensive?
3. M: It obviously is (jokingly).
4. T: (laughs) makes sense
5. M: They are, they got this cool game over there that was for the Gameboy advance regular.
6. T: mmhum
7. M: And it was Asterous Gun Oblix (in german) which is like Viking Guys.
8. T: mmhum
9. M: They speak German for some reason. They're Vikings that speak German and there there, that's their Mickey Mouse and it was a really cool game but it was so expensive so I couldn't get it.

[Johnny and Mikey 2005-09-02_00:39:59.08]

As a collector Mikey gathers games so he can actually play them, rather than have them sit on a shelf. The game Mikey did purchase in Germany, *Pokémon Crystal*, originated in Japan and is available in an American version. Mikey reported that while he does not own the American version some of his friends do. In Segment 1.10 Mikey points out that in the German version of the game the motive of the “rival” is “completely different” from the American version (see Segment 1.10 line 9). In the American version the rival wants to be a better trainer while in the German version the character wants to “kill you.” Mikey’s comparison of the German and the American version of the game indicates that as a collector he does not just gather games to put on display, rather he plays the games he collects and sees differences in their in-game action.

Segment 1.10

1. M: I got a cool video game in Germany
2. T: oh yeah.
3. M: Pokémon Crystal
4. T: What one?
5. M: Pokémon Crystal
6. T: oh yeah you got it for the=
7. M: =It's in German so its=
8. T: =for the Gameboy?
9. M: mmhum. When I translated it your rival has like completely different motives than the real one, I mean than the American version.
10. T: really?
11. M: yeah.
12. T: the characters do?
13. M: yeah its- everybody's different some, some of the characters even swore when they lost.
14. T: really?
15. M: I- yeah it's weird.
16. T: hun.
17. M: um. your rival is out to actually kill you, instead of just 'I wanna be a better trainer than you', 'I want to kill you'
18. T: oh

[Johnny and Mikey 2005-09-02_00:36:17.28]

In the exit interview Mikey and Johnny showed me tens of video games they had collected over the years. These are made for different game consoles (which they also owned). As shown in Segment 1.5 (line 4), Mikey still holds some of these older systems and games in high regard; “they always had the best games”. During our study I did observe him playing these systems. His collection *and* play of older games and game systems indicates that he is organizing his resources to play games for an extended period, possibly years or an entire lifetime.

I have laid out five dimensions to Mikey’s relationship with video games: a career player, a critic, a knowledge resource, a broker to the gaming world, and a collector. Each of these dimensions points to ways that games connect to other aspects of his life, primarily through friends and family. The study, which this dissertation is based on, has extended to follow some of the same participants as they do homework. In Mikey’s case I have seen how his interest in gaming has had a direct impact on his school practices. Mikey reported to me that after he obtained a graphing calculator he wanted to figure out how to put video games on it and read the entire manual. By reading the manual he learned how to program equations into his calculator, which he uses in math class, something he did not learn from his math teacher. To put programs on the calculator Mikey also purchased a cable to link the calculator to his family’s computer. He then discovered a program for his calculator that mimics flashcards for learning vocabulary words. Mikey now uses that program and has over 400 words stored on his calculator. I have raised this to show one specific way that Mikey’s relationship with games has had an impact on other non-gaming aspects of his life.

Katarina: Games as a place to explore

Katarina's relationship with games can be characterized as a means to exploration activities. When I asked Katarina to show me the games she plays the resulting "tour" was strikingly different from the one Johnny and Mikey gave. In comparison to Johnny and Mikey's collection of tens of games, multiple game consoles, and magazines Katarina brought out only a few discs and spoke of five or six games. Throughout the study I saw her play only six games two of which were sequels to other games she played more frequently during the field visits (i.e. Zoo Tycoon and Zoo Tycoon 2). Her collection indicates that she may be setting herself up quite differently than Mikey for future game play. While talking about the Harry Potter games Katarina mentions aspects of the games she likes and does not like (see Segment 1.12). When playing Harry Potter she likes to have her character, Harry, wander around the space and "explore and just bump into random people." Katarina's relationship with games is influenced by what might be considered her leading activity (Beach, 1995). The concept of a leading activity is used to show how categories such as play, school, work, and retirement impact the development of practices. In Katarina's case her leading activity in game play is exploration, which impacts the kinds of games she plays and how she plays them.

Segment 1.12

K: This is the first Harry Potter game (T: unhun) and um you just basically you go to every lesson you have to go to and I've been to three or four, I'm not sure. And there is some quitchie [*sic*] games and you kind of walk around exploring and trying to find themes but that's like- that's not part- that's not necessarily something you have to do but it has bad graphics, I'm sorry but that bothers me greatly (T: unhun) and so that's why I like the second Harry Potter better (T: mhem) because it has better graphics and you get to walk around more and explore and just bump into random people and chase them and you basically find more places, like secret places and that's what I like about it. But what I don't really like about it

that there is this one place where I can't get past (T: mmhum) so I'm stuck on that stopped playing it for a while.

T: which place is that?

K: It's like, there's these snails and they really bother me because I can't get past them (T: mhem) and they keep killing me and so I get freaked out at them and I just run away, stop playing the game and but sometimes I start over on it, and I like that more than the first game which I've said already.

[Katarina 2006-02-24_00:02:54.10]

In Segment 1.12 Katarina says one aspect of the *Harry Potter* games that she enjoys is that she can “explore.” This is consistent with her play of the game during my field visits where she would play through some of the “lessons” in *Harry Potter* until she was able to walk around the three-dimensional space that the game is set in. On some occasions she would use a saved game file to skip the lessons and go right to walking around. Using a saved game file was possible because prior to enrolling in the study Katarina played the game with her cousin, who completed the lessons. In other words, Katarina was making use of her cousin’s progress in the game as a means to have the kind of interaction that is consistent with her exploration activities.

Katarina’s statement in Segment 1.12 also points to an aspect of the game that conflicts with her exploration activities; “there's these snails and they really bother me because I can't get past them... I just run away, stop playing the game.” I have observed Katarina work around that part of the game. The first time Katarina played *Harry Potter* while I was there she started the game over from the beginning because, from her report, she had gotten to a hard point in the game and was unable to beat it. I believe she was referring to the part with the snails. During the next field visit Katarina encountered the part of the game with the snails that she mentions in Segment 1.12. She then actively looked for ways to get past this part of the game without actually doing the challenge. At

first Katarina left the game running but did nothing with her character. She used a counter in the game and a calculator in her hand to figure out how long her character would have to sit there before the challenge ended. She then opened up a web browser to look for a cheat. Her web search ended up being unsuccessful. Eventually she decided to restart the game and use her cousin's progress to skip the snail portion. In Segment 1.13 she says that she will go to "six or wherever [her] cousin played" which turned out to be a place where she can walk around the game freely. We can also see in Segment 1.13 that Katarina says that she likes "walking around in the game" four and a half months prior to a similar statement in Segment 1.12 where she relayed similar thoughts. Katarina's interactions with *Harry Potter* and the snail portion of the game in particular show how her relations with games, which is based on exploration activities, is used to organize resources in the game, on the Internet, and in the room.

Segment 1.13

K: It's not five anymore it's going to be six or whatever my cousin played. (5 sec.) I wish you could just like get all the spells and walk around the grounds getting beans and stuff.

T: Would that be more fun?

K: I like walking around, I don't like battling people. I like walking around in the game.

[Katarina 2005-10-05_01:11:39.04]

Katarina's exploration activities are also present in her play of the game *Zoo Tycoon* where she organizes in-game resources in a way that is consistent with her leading activity. On *Zoo Tycoon* Katarina says, "I think that I like it more than other games because I design things." Throughout my observations she uses the term "design" quite often in descriptions of her play in *Zoo Tycoon* to reference how the zoo looks. In *Zoo Tycoon* the player is charged to build and maintain a working zoo with a set of tools

that allow for shaping land, adding plant life, building exhibits, and adding other preformed structures to the zoo. Katarina uses the in-game tools to explore various design alternatives. In other words, her relationship with games, as a place to explore, has implications for how she engages with the resources in the game.

My observations of Katarina's play in *Zoo Tycoon* indicate that her exploration activities are present in her emphasis on the aesthetic appeal of her zoo and her eventual divergence from the zoo's mission. She begins each zoo by using a "cheat code"² that allows her to add money to her account. She then uses pre-formed buildings and items such as benches, trashcans, fences, and walkways to add guest attractions and to build a food court. Katarina will then make a few animal exhibits. In her zoos there are not a large number of exhibits, usually only two or three, but attention is paid to how the trees, rocks, and other formations look. After an animal is placed in the exhibit she uses the zookeeper recommendations to adjust the exhibit to make the animal happy. At some point (45-75 minutes) Katarina's attention diverges from building and maintaining the zoo to other activities in the zoo space that are not directed towards building or maintaining the zoo. For example, she will build fortresses to trap unhappy guests or zoo employees. Katarina will also experiment with placing different kinds of animals together. I take her actions in the game, designing a zoo that is "pretty", trapping workers and guests, and placing different animals together as a demonstration of her relationship

² "Cheat codes are codes that can be entered into a video game to change the game's behavior." (Wikipedia entry for "cheat code") For instance Katarina uses a cheat code in *Zoo Tycoon* that gives her unlimited funds.

with video games. Katarina's relationship with video games is based on exploration as a leading activity.

Katarina's play of the two games I have described thus far have differences and similarities. In the game *Harry Potter* Katarina likes to "walk around" and "explore", and while she does engage with the games pre-given challenges when they become difficult she actively seeks ways around these difficulties. In the game *Zoo Tycoon* Katarina builds and designs zoos as the game intends placing an emphasis on how the zoo looks, however quite frequently her activity diverges from building and maintaining the zoo. On these occasions she actively occludes the game's instructions. In both games, *Harry Potter* and *Zoo Tycoon*, Katarina organizes in-game resources in a way that is consistent with her leading activity, exploration.

Katarina's exploration activities are not as clear in *Pharaoh*, another game she played in our study. *Pharaoh* is a city building game set in ancient Egypt. When describing *Zoo Tycoon* she compared the game to *Pharaoh*, "it's pretty much the same thing except you build a zoo instead of an empire" (Katarina 2005-02-24). When playing *Pharaoh* Katarina sticks closely to the game's pre-given tasks, which may indicate that she is doing less of the exploration than she does in *Zoo Tycoon* and *Harry Potter*. I did not observe her engage in any kind of "free form" type activities where she built unconventional structures or diverged from the games suggested narrative. *Pharaoh* is also a game that Katarina reported having played less than the other two when the study began so it is possible that in the time that I observed her she was still learning to use the game in a more exploratory fashion.

Recall Katarina's statement from Segment 1.2 that what she does in games "you don't really get to do it in real life." As an indicator of Katarina's relationship with games this statement is helpful when trying to understand her actions while playing video games. Not only does she have an opportunity to walk around and explore with Harry Potter, build a zoo, or run an Egyptian empire but she also has an opportunity to diverge from scripted activities without any serious repercussions. Katarina, then, organizes resources in the context of video game play to engage in exploration activities. This raises a question our research group has begun to empirically consider through an extension of the study; how does Katarina display a similar kind of disposition at school or during other activities?

Vanessa: Family, friends, and narrative

Vanessa's (age 13) relationship with games can be characterized as a resource for developing herself as a person in other aspects of her life. As I will describe, for Vanessa video games are a "family thing", a resource for positioning herself with friends, and means to learn "morals". In many ways Vanessa's relationship with games comes through in her engagement with the game's narrative. To varying degrees video games are structured around a narrative. Take for example a typical role-playing game where the player engages one or more characters in a long drawn out story often set in a fantasy world. Compared with a typical fighting game, where the player mostly engages characters in short battle sequences, role-playing games are heavily dependent and built around narratives. Regardless of the style of game I observed Vanessa play she took up and paid attention to its narrative. The narrative then was used as a resource for

developing herself as a person, which is an important element of Vanessa's relationship with games.

Vanessa's relationship with video games is a means for her to develop and define herself as a person in her family life. Recall Vanessa's statement in Segment 1.3 above that her father introduced her to video games; "my dad taught me how to play." Later in the same interview she expanded on her father's role in her game play by reporting that he taught her how to play beginning at the age of 3.

Segment 1.14

V: We've been playing video games since I was three. My dad taught us how to play, so it's been like a family thing for years, except for my mom she doesn't like to play-

[Vanessa 2006-02-16_tape2_00:10:33.29]

Her statement is consistent with what both her parents told me early in the study. Although all members of the family report that Vanessa's father has had an influence on her play, their play is differentiated by the games they select. Vanessa plays some of the same games as her father, however as Segment 1.15 (lines 15 – 21) shows she actively rejects two distinct types of games that he plays: army and sports games. By rejecting these games Vanessa is using their narrative to define a distinct place for herself inside her family life, and so Vanessa's relationship with games is a means to develop an aspect of her life.

Segment 1.15

1. ((Vanessa [V] is playing The URBZ [pronounced herbs], a version of the Sims where the object is to help gain reputation in an urban environment. Her dad [D] walks into the room. Vanessa tell him that she had thought he was her brother entering the room.))
2. D: Why are you playing that boring game?
3. V: You never even played it, so how do you know?
4. D: It looks boring, I couldn't get into it.
5. V: You never even played it.
6. D: I know but I can't get into it. I seen [her older brother] playin' it last night.
7. V: This?
8. D: Yeah, is that the URBZ four, the URBZ whatever?
9. V: yes
10. D: Yeah he was playing it last night.
11. V: Maybe he liked it.
12. D: Yeah whatever. ((Her dad leaves the room.))
13. V: (3 sec.) ((Turns to look at TS)) He likes those army games and all those, ((shakes her head)) boring.
14. T: Your Dad?
15. V: Yeah, he likes the boring, I say his games are boring. The only he likes is the army and sports. I don't like those games.
16. T: You don't.
17. V: No.
18. T: Why not?
19. V: I never got into- I played 'em before, itsjes they're all boring.
20. T: mmhum
21. V: The only thing you do is just shoot people or either just pass the ball. That's the only thing. (8 sec.) I mean, I enjoy shooting other things, but just constantly ((shakes head)) tryin' to fight for something. (8 sec.) Plus I never want to be in the military anyway. (10 sec.) I'd rather stick to science or something.

[Vanessa 2005-12-01_01:22:27.23]

The interaction between Vanessa and her father in Segment 1.15 (lines 1 – 12) is a demonstration of how Vanessa uses video games to carve out a place for herself in her family life. On line 2 we see that when her father declared the game she is playing as boring, Vanessa retorted with a similar comment on the games he plays. By actively declaring that his games are boring she positions herself and her game play as different

from her father's play, and so her relationship with games is defining a place for her in her family life.

Vanessa also uses video games as a resource for developing her life outside of the family's home. Segment 1.15 ends with Vanessa's statement that her lack of interest in her father's games is also related to her not wanting to enter the military (line 21). It seems that Vanessa is choosing video games in relation to an imagined future she has set for herself. This is another demonstration of how Vanessa uses her relationship with games as a resource for developing herself outside of the gaming world. More specifically consider the game Vanessa was playing in Segment 1.15, the *URBZ*. The object of this game is to gain reputation through social interaction in an urban environment. When Vanessa showed me her collection of games she mentioned the *URBZ* even though the disc was not present (see Segment 1.16). Her explanation of the *URBZ*, in Segment 1.16, included that she thought the game was "kind of cool" because it showed her how to build a reputation. In comparison with her statement, in Segment 1.15 (line 21), that she does not like military games because she never "want[s] to be in the military" we can infer that Vanessa likes to play the *URBZ* because it will show her how to "build a reputation" a connection to her social life outside of her game play and her family life. In other words, Vanessa is using the game as a resource to develop her social life, meaning her relationship with games is implicated in her development as a person.

Segment 1.16

V: And then the other games that have that I don't, er that are not here with me are the *URBZ*, which is a city, supposed to be city based, like suburbs but in downtown. That is kind of a cool game because shows you, kind of shows you what you have to do to build a reputation. That's what some people would want to build a reputation, become popular.

[Vanessa 2006-02-16_tape1_00:12:51.06]

My conversations with Vanessa indicate that her relationship with video games intersects more directly with her social life. This is evident in how she talks about sharing knowledge of video games with her friends. For instance, in Segment 1.17 (line 7) Vanessa told me that she was holding off on sharing a newly found video game web site because she liked having new information. This indicates that Vanessa is using her knowledge of video games as a means to be a certain kind of person amongst her friends, a person that knows things first. Video games then are a resource for the development of her position amongst her friends.

Segment 1.17

1. V: Actually I never told my friends about the web site yet.
2. T: You haven't?
3. V: No, not yet.
4. T: You just tell them all the stuff you=
5. V: =yeah, they actually wonder why- how do I know all this stuff.
6. T: Oh, (laughs), you gonna tell 'em or just keep it a secret?
7. V: Actually, I am gonna tell um. It's just that (laughs) I like to know the stuff first.

[Vanessa 2005-11-03_01:02:58.04]

As I mentioned above Vanessa engages with game narratives as a resource to develop herself as a person. Narratives can play different roles in video games. In certain cases they shape much of the player's interactions with the game, in other cases the narrative plays a less substantial role. Recall in Segment 1.16 Vanessa's description of the *URBZ* includes both setting and character development; "in downtown ... shows you what you have to do to build a reputation." Vanessa then is using the game's narrative as a means to learn about building a reputation in an urban environment.

Vanessa's engagement with the narrative aspects of video games came out when I asked her what she learned while playing video games. She quickly responded that she

learned “morals” and then made reference to narrative elements of the games. For instance from the game *Kingdom Hearts* she said she learned to stick with her friends since within the game’s story line two characters had a disagreement but ended up needing each other in the end. What is striking about Vanessa’s comment on learning morals from video games is that morals are commonly thought of as something learned from another person. This person, generally speaking, is someone close—a friend, family member, clergy, etc. It seems then that Vanessa’s relationship with games has a degree of intimacy that allows her to use them as a resource for developing an important aspect of herself, her value system.

Game relationships and the real world

I began my analysis with the suggestion that each of the participants played games for primarily the same reason, “to have fun”. By looking across the relationships I described above, it is apparent that these kids engage with video games in strikingly different ways. The difference, in many ways, is based on how video games are positioned amongst other aspects of the kid’s life. Differences in how kids position video games in their lives speaks to a need to expand beyond the separate worlds view of game play (Stevens, Satwicz, McCarthy, in preparation).

One of the implications of an expansion beyond the separate worlds view is that the “identity work” (Gee, 2003) that is said to be a part of playing video games extends beyond the player’s interactions in the game environment and includes other aspects of life. Gee (2003) describes an “Identity Principle” that is built into video games. This principle involves three identities that a player juggles while learning to play a video game.

Learning involves taking on and playing with identities in such a way that the learner has real choices (in developing the virtual identity) and ample opportunity to meditate on the relationship between new identities and old ones. There is a tripartite play of identities as learners relate, and reflect on, their multiple real-world identities, a virtual identity, and a projective identity (Gee, 2003, pg. 67).

Gee (2003) argues that video games allow for three kinds of identities: virtual, real and projective. As I see it, he uses these three identities to describe the relationship between two actors in the game context, the player in the room and the character in the game, and to highlight the potential benefit the interaction has for the player. The three identities Gee describes each locate agency in a different place. In the virtual identity the agency is located in the character that lives in the game. In the real identity agency is located in the player living in the real world. In the projective identity agency is located in the transmission between the player and the character.

The analysis I presented above suggests that with respect to video games identities are in play beyond the time the player is interacting with the game. This is especially evident in Vanessa's case where she uses video games to position herself as a distinctive person in her family and amongst her friends. The role of video games play in the formation of an identity is also apparent in Mikey's collection of magazines as a means to be someone that people come to with "a question about gaming" (Segment 1.6, line 13). In other words, the identity work in relation to video games involves more than what goes on while the game is being played because games are a resource for defining the kind of person the player wants to be in the real world.

My analysis also suggests other ways that video games are implicated in the participants' lives. For instance, Mikey and Vanessa not only play video games within

their family unit but also with friends. In contrast Katarina typically played games on her own and often asked her younger brother to leave the room while she was playing. She also rarely spoke of playing or discussing games with other friends, with the exception of her cousin whom she played *Harry Potter* with. In other words, kid's relationships with games have a variety of social components.

Mikey's, and Vanessa's, relationship with games also seem to influence how they choose games to play. On several occasions Mikey placed a great deal of importance on "gameplay" in determining which games to play. For instance, when asked by his younger brother Johnny if he would have played *Kingdom Hearts* if it had graphics from an older game system, Mikey responded that he would as long as the gameplay was the same. On a separate occasion Mikey told me that the game play in *Kingdom Hearts* was "more action based rather than waiting your turn and everything." In contrast Vanessa never mentions gameplay as a reason for playing the same games that Mikey discusses, instead she discusses playing the games for their narrative elements.

The difference in Mikey and Vanessa's relationship with video games is also present in what they report learning from them. Mikey told me he learned "persistence" and "planning" while, as I described above, Vanessa said she learned "morals". Mikey then related persistence and planning to sequences of actions in the game such as continually battling to build up a character's strength or planning out how to achieve a particular goal. On the other hand Vanessa said she learned the importance of sticking with her friends and related it to parts of the story line in *Kingdom Hearts*. She also said she learned not to trust everyone from playing *Tekken* games. Katarina on the other hand reported learning methods of design and related it to her play of *Zoo Tycoon* and

Pharaoh. As I described above her relationship with video games is different than both Mikey and Vanessa's. Katarina likes to explore the games space and to design within the game. She engages with a game's story line and predetermined challenges until she is able to explore the game space. It appears then that the kind of relationship these kids have with video games has implications for what they take away from them. This is a significant point to consider because it challenges the view that when dealing with programmed media actions and outcomes are narrowly defined (Bijker & Law, 1992).

Across these three cases we can see that kids approach games with different intentions and as a result they select different games and have different kinds of relationships with them. Although they all cite entertainment as a reason for playing video games each of the participants reports taking something different from their play of video games. I will use this as a starting point to further break down the participants' play of video games, how they engage with them, and how they learn to play them.

Chapter II: Making and Breaking Routines

Recurrent activity in video games

In this chapter I will examine one of the more notorious qualities of video games as they are presented in the popular media. Video games are often characterized as a useless repetitive activity. This view of game play is part of what has placed them in a dubious position and opened them up for attack by cultural critics. Take, for example, the commentator Michelle Malkin's characterization of game play: "Sitting in front of a video game screen is ... a self-absorbed and stultifying recreational indulgence" (Malkin, 1999). My analysis here is an attempt to better understand what comprises the repetitive activity commonly associated with video games. I will do this by looking into how repetitive activity is made and broken through the course of play. By looking at how sequences of recurrent activity change over time I am able to describe part of the learning process that takes place in the context of video games.

Here I use Hutchins' definition of learning as "adaptive reorganization in a complex system" (Hutchins, 1995a, p. 289) as a starting point for looking at changes in routines. On Hutchins terms "the relevant complex system includes a web of coordination among media and processes inside and outside the individual task performers" (Hutchins, 1995a, p. 289). As a concept then, the complex system, or "socio-technical system", is useful when considering how young people interact with video games and the media that make up the context in which they are played. In addition, Hutchins' definition of learning is useful for analyzing the making and breaking of routines because it speaks to the reorganization of people and artifacts that occurs with a change in activity. My

analysis, then, of making and breaking routines is a means by which I can understand the process young people use to learn to play video games.

By *routine* I am referring to a repetitive sequence of actions. The repeated actions do not have to be identical, but should serve the same function, purpose, or goal; and/or make use of the same resources; and maintain the structure of the activity. Routine *making* is the process by which a routine is started and stabilized through the assembly of actions and resources. *Assembly* refers to the *mobilization* of actions and resources in relation to each other. *Breaking* a routine is the end or significant pause of the recurrent sequence of actions.

As pointed out by Bransford, Vye, Stevens, et al (to appear), Hutchins' definition of learning echoes Hatanao and Inagaki's (1986) notion of "adaptive expertise." The notion of adaptive expertise grew out of cognitive science's long history of research investigating mental differences between novices and experts. Much of the cognitive science work characterized experts as being better problem solvers than novices as evidenced by the experts successfully forming efficient mental routines. Hatano and Inagaki (1986) challenged the efficient notion of expertise by drawing a distinction between "routine expertise" and "adaptive expertise." Adaptive expertise is characterized by "flexible, innovative, and creative competencies" (Hatano & Oura, 2003, p. 28) and may be best developed with activities that encourage innovation and efficiency (Schwartz, Bransford, & Sears, in press). Several questions remain regarding the nature of adaptive expertise and its relationship to learning in everyday situations. Both

innovation and efficiency are broad and undefined terms, and their relationship is unknown. Bransford, Vye, Stevens, et al (to appear) suggest we ask:

...how people can become *both* efficient and innovative so that they can continually adapt to change. The issue may well be how to strike a balance in developing expertise that plays to the strengths of both efficiency and of innovation. How this may be achieved is a frontier issue for research in learning sciences and education.

My analysis of routine making and breaking in video game play draws parallels to adaptive expertise in that I will see how young people are adaptive when setting up routines. Video games are a good context for examining the relationship between routines and innovations, because game play involves both repetitive actions and novel challenges that require an ability to adapt to new situations within a space of recurrent activity.

Between Hutchins' definition of learning and the notion of adaptive expertise, understanding adaptive activity has become a common interest for different perspectives in the learning sciences. My intention here is to use the making and breaking of routines during game play as a means to understand adaptive activity.

In my analysis I avoid relying exclusively on mental descriptions of routines by showing them as an assembly of social, material, and cognitive resources. My analysis draws on naturalistic studies of human activity that have provided rich descriptions of routines. For instance Hutchins (1995a, 1995b) has provided accounts of routines on navy ships and in the cockpits of airplanes. His descriptions have shown how human interactions in a socio-technical system form recurrent activity such as monitoring an airplane's speed or fixing coordinates on a navy ship. Sylvia Scribner (1997) used the routines of dairy workers to understand how mental strategies were developed to avoid

either unnecessary physical labor or recurrent mental calculations. The mental strategies Scribner described were based on the material arrangement of the warehouse. De la Rocha (1986) described “personal inventions” used in the development of kitchen routines in a popular diet program. These personal inventions grew out of what she termed “chronic snags” which occurred when individuals ran into recurrent or persistent problems. Across naturalistic studies of human activity routines are shown as contingent on more than mental activity involving social and material aspects of the situation. In my analysis I use an approach, common in naturalistic studies of routines and innovations, that expands the relevant unit of analysis beyond individuals to include the socio-technical system as a frame for understanding the routines of video game playing. By expanding the unit of analysis to include the socio-technical system when looking at the making and breaking of routines, I am able to show that the “flexible, innovative, and creative competencies” (Hatano & Oura, 2003, p. 28) that characterize some forms of adaptive activity are distributed across the socio-technical system.

The structure of my analysis

My analysis of recurrent activity during game play looks across three separate cases involving different children and different video games. Each case begins with a description of one or two routines. I then describe the routines’ making and breaking. Finally, I end each case with analysis of *how* the routine was made and broken by revisiting my descriptions and drawing on other instances from the participant’s game play.

Katarina: Routines that live across games

This case presents an analysis of a recurrent activity in Katarina's play of the games *Pharaoh* and *Zoo Tycoon* to show the making of a routine as an activity distributed across different parts of a socio-technical system. I will begin with a description of two similar routines, one from Katarina's play of *Pharaoh* and one from her play of *Zoo Tycoon*. In both of the routines Katarina implemented an approach that she called "design the basics first". From there I will focus my attention on the making of the routine in *Pharaoh*, a new game to Katarina when my observations began. My description of the *Pharaoh* routine's making shows that by implementing the "design the basics first" approach Katarina replaced a third routine where she did not use the "design the basics first" approach. The new routine in *Pharaoh* mimicked her routine in *Zoo Tycoon* and grew out of a problem she was having in *Pharaoh*. I will then use instances from my field visits and interviews to analyze *how* the routine's making in *Pharaoh* involved her play of *Zoo Tycoon* and a persistent problem she was having in *Pharaoh*. The case shows that making of this routine was an adaptive activity made possible because parts of the socio-technical system were flexible.

What is the routine? "Design the basics first"

Katarina's "design the basics first" approach is directly related to the primary activity in the games *Pharaoh* and *Zoo Tycoon*. The object of both games is to actively design and place structures in an open space. In *Pharaoh* the primary activity is to build cities in ancient Egypt. Each city starts with an expansive space of empty land upon which the player builds by adding objects like homes, roads, and other structures. *Zoo*

Tycoon begins with either an empty or partially constructed zoo to which the player then adds in an effort to build and manage a working business. A variety of objects are used to construct exhibits, food courts, and other guest attractions. In other words, the activity in both games involves designing and building structures where people live, work, and play. Katarina's "design the basics first" approach means that her cities and zoos start with the specific placement of some items and not others to help minimize the number of tasks she has to do to achieve her goals.

To manage tasks in the games Katarina recurrently selects and places particular objects when beginning new zoos or Egyptian cities. Picking certain items to begin her cities and zoos characterizes two routines, one for starting *Zoo Tycoon* and one for starting *Pharaoh*. Both routines are based in her "design the basics first" approach to the games. In both games placing particular objects results in an increased presence of people, either zoo visitors or citizens of the ancient city. The presence of these people is an inherent aspect of the game, however they often create additional tasks and complications for Katarina. For example, in *Pharaoh* when Katarina places new houses in her city an influx of new people move to the city. The presence of new people in the city then creates a need for food, jobs, and other services which means Katarina has more to do. In *Zoo Tycoon* adding an animal to an exhibit means visitors will come to the zoo, which creates a need for food services, bathrooms, and other entertainment. Adding an animal also means that the animal will have specific needs such as comfort and food to which the player needs to attend. In both games Katarina builds the services zoo visitors or citizens need first, "the basics", before adding the objects that attract people to the city

or the zoo. By not building houses or adding animals Katarina makes it so people do not enter the city or the zoo, she believes this allows her to avoid certain problems in the game. While Katarina's "design the basics first" approach shapes recurrent activity in both games, it was not always implemented in her play of the game *Pharaoh* during my observations.

During the last moments of Katarina's exit interview I asked for her own perspective on what she learned while playing video games. She answered by talking about "build the basics first" as a design "method" (see Segment 2.1).

Segment 2.1

TS: Ok, so tell me what you think you learn while playing video games?
(3 sec.)

K: Kind of like theories- the::ries, methods. Um
(2 sec.)

TS: What do you mean by theories and methods?

K: Like methods of designing things.

TS: mmhum.

K: I guess like that's like Zoo Tycoon, Pharaoh stuff and uh (2 sec.) Harry Potter I don't think you really learn anything from it (laughs). I mean, I don't know like, I don't know anything but, well I don't know anything about the subject but um.

(3 sec.)

TS: Can you give me an example of a method that you designed-- a method that you have designed that you learned? From Pharaoh or Zoo Tycoon.

K: I guess like um (4 sec.) like design what. the basic first.

TS: mmhum.

K: And then when people start judging or something then you start tweeking it and like (3 sec.) making it perfect. Like first have the basics and then go to perfect it. Not perfect it as you go along, I guess. ok, I don't really know I've never really thought about it. I mean I don't know what I really learn.
(laughs)

[Katarina 2006-02-24 exit-interview2_00:11:15.12]

The implementation of Katarina's "design the basics first" approach is present in her play of *Zoo Tycoon* and *Pharaoh*. In *Zoo Tycoon*, Katarina would first build an

expansive food court and other facilities for the zoo guests, which characterized her routine for starting the game. This routine was present in her play of *Zoo Tycoon* throughout my observations. *Pharaoh* was relatively new to Katarina when I started my observations and so the “design the basics first” approach was not always present. Throughout most of my observations Katarina did not “design the basics first” while playing *Pharaoh*, instead she started her cities by building houses first. Over the time I observed Katarina she began making a new routine where she would hold off on starting her city with houses in response to a persistent problem she had in the game. In the next section I will describe the role Katarina’s “design the basics first” approach played in the making of her routine for starting cities in *Pharaoh*.

A description of making Katarina’s routine for starting cities in Pharaoh

Katarina’s routine for starting cities in *Pharaoh* resulted in part from a chronic snag (de la Rocha, 1986) she encountered while playing the game. A chronic snag is a persistent problem present in an existing practice. It occurs when then there is the introduction or arrival of something new that disrupts some part of the existing practice. If the disruption reoccurs and reaches a level of felt chronic-ness to the person, then it is a chronic snag. De la Rocha (1986) used the concept of a chronic snag to investigate how people created personal inventions to overcome persistent problems in their daily lives. Here I use the concept in reference to a persistent problem that Katarina encountered in her play of the game *Pharaoh* that eventually gave rise to an adaptive activity and the making of a new routine. The chronic snag Katarina frequently ran into occurred when the game would tell her that the city needed more workers while at the same time telling

her that food levels were low; she interpreted these as competing requests and referred to their appearance at the same time as a “problem”. My description of the making of Katarina’s routine for starting a city follows the development of this chronic snag because it relates to Katarina’s reported reason for using the “design the basics first” approach. The chronic snag created a context for an adaptive activity that resulted in a new routine.

Katarina encountered the need for more workers and low food snag early in my observations. She was working on her second city in *Pharaoh* during my first field visit when she was told by the game that employees were needed for the city. She built a temple, and then placed several houses around it (see Figure 2.1). Her expression at this point was subtle, but one that could be reasonably interpreted as an indication that she noticed something odd. When placing the houses a small stream of text at the top of the screen told her that food levels were low. Her eyes looked up a couple of times. She moved her hand away from her face and slightly shook her head. The game play continued from there and within just a few minutes the game told her she had successfully beat the scenario [Katarina_2005-08-24_00:18:14.06]. This small moment would normally go unnoticed, however I sought this particular instance out from the video recordings because over the months that I observed Katarina, her recognition of the snag became increasingly common. Eventually the persistent nature of the snag led to an adaptive activity and the making of a new routine for starting cities in *Pharaoh*.



*Figure 2.1: Katarina is playing the game *Pharaoh* and has been told by the game that her city is low on food and needs more workers. In this early instance of her playing the game, she moves her hand away from her face and slightly shakes her head.*

The next field visit that Katarina played *Pharaoh*, one month after her subtle reaction to the snag, she worked on four cities. Over the course of working on these cities Katarina's reaction to the snag became more pronounced. In the first city, the game told her she needed more workers while at the same time a plague occurred. Katarina reacted to this with some amount of frustration as the transcript in Segment 2.2 shows. The transcript includes in-room action along with in-game action. In-game action is noted by the use of double parentheses “(())”.

Segment 2.2

((Places an apothecary in the city. A note from the game comes up that says, "Your city needs more workers."))

K: I know my city needs more workers. (3 secs.) Stop bugging me all the time.

[Katarina_2005-10-26_00:01:10.02]

The next city Katarina worked on during that field visit was one she had begun on a previous occasion and saved on her computer. After about seven minutes of working on the saved city, Katarina once again made reference to the need for more workers while food levels were low (see Segment 2.3). At this time Katarina's routine for starting cities

involved building houses first and so it did not follow the “design the basics first” approach.

Segment 2.3

K: Wow, that's a problem. I have too few people to work and we're making too little food. Yikes.

[Katarina_2005-10-26_00:27:52.12]

In the final city Katarina worked on that day she built houses before the other kinds of buildings, not following the “design the basics first” approach. Therefore her routine based on the “design the basics first” approach was still in the making. Well into this city Katarina described the game's request for more workers while food levels are low as a consistent problem and an annoying one (see Segment 2.4).

Segment 2.4

((Places a few houses down. Game puts up several messages that say: "People already eat more food than they produce."))

K: "This is always a problem (3 sec.) like um-

TS: What's always a problem?

K: I need more workers.

TS: uhuh.

K: But there's either too ma- too little food or there's already enough people unemployed, which gets real annoying.

[Katarina_2005-10-26_01:26:50.16]

After having observed Katarina play *Pharaoh* on two separate occasions (8/24/05 and 10/26/05) it was evident that she frequently commented on a persistent problem in the game. The game would tell her that she needs more employees while at the same time warn her that the current population eats more food than it produces. She interpreted these as competing demands and therefore saw the two messages as a problem.

Katarina continued to encounter the snag during the next two field visits on 11/2/05 and 11/11/05, which eventually led to her implementing the “design the basics

first” approach in *Pharaoh*. By implementing this approach Katarina was making a new routine and the socio-technical system was adaptively reorganized. On 11/2/05 her pattern remained consistent and she did not follow the “design the basics first” approach—she built houses at the start of her city, before other structures were in place. Although the snag persisted, it often did not keep her from successfully completing some scenarios, so one might consider it a minor problem. Eventually though Katarina did use the “design the basics first” approach and waited to build housing until other structures were in place. This action then marks the making of a new routine. In Segment 2.5 we see Katarina’s comments as she implemented the “design the basics first” approach and started a city without initially placing housing down. Her statement at the end of Segment 2.5, that she is not building houses so people “can’t complain about lack of jobs or whatever” indicates that her using the “design the basics first” approach in the making of this routine is in response to the chronic snag.

Segment 2.5

K: I can't believe I'm allowed to do this, like build stuff before I have people.
(4 sec.)

T: Have people just not started to move in?

K: No, cause I didn't build houses (snickers).

T: oh.

(2 sec.)

K: Which you know makes plenty of sense.

T: yeah. (2 sec.) so, do you not want people to move in yet?

K: no I want to [inaudible] it off so that later they can't complain about lack of jobs or whatever and so I don't have to build it while they're complaining.

[Katarina 2005-11-11-05_00:39:15.17]

Katarina did not play *Pharaoh* for two field visits after she implemented the “design the basics first” approach but returned to it on 11/30/05. She worked on four cities during the field visit on 11/30/05. The first three she ended early, before I was able

to tell whether the “design the basics first” approach was used. The fourth and final city on which I saw her work showed a return to her old habit of building housing before other structures were in place and the “need more workers and low food” snag returned. This was the last time I observed Katarina play *Pharaoh*.

How the making and breaking happened

To begin my analysis of how Katarina came to use the “design the basics first” approach to her city building in *Pharaoh* I want to pose a discrepancy between advice Katarina said she would give someone that had just started playing *Pharaoh* and instructions she read while playing an early level of the game. The discrepancy is that the game tells Katarina to build housing first and Katarina’s advice is to *not* build housing first. I raise this discrepancy to show that her application of the “design the basics first” approach did not come from instructions given by the game. Instead this approach came from her routine, described above, for starting zoos in *Zoo Tycoon*. Prior to using the “design the basics first” approach Katarina’s routine for starting cities mimicked the advice given by the game, she built housing first. Her advice was given during the exit interview when I asked the following question (see Segment 2.6).

Segment 2.6

T: If somebody was gonna say-- let's say Pharaoh since it's on the top there. ahh. was gonna pick the game up, had just bought it and asked you for advice on how to beat it or how ya know- to be good at it or whatever. What would you tell 'em? Would you tell that person or friend of yours?

[Katarina 2006-02-24 exit-interview_00:04:44.17]

Katarina responded to my question by suggesting that the new player build the main buildings first (see Segment 2.7) before building houses. This suggestion is

consistent with the “designing the basics first” approach that influenced the making of her routine for starting cities in *Pharaoh*, but does not follow advice given by the game.

Segment 2.7

K: Like I'd say that, like, build the buildings first because or else you'd have to build the main buildings before you build the houses or else the people start coming in then there's like all these complains- complaints about lack of jobs and um sickness and stuff. (T: mmm)

[Katarina exit-interview_00:04:44.17]

Katarina's suggestion in Segment 2.7, to “build the main buildings before you build the houses”, stands in contrast to advice a new player is given by the game when starting *Pharaoh*. Katarina read the following information 5 times during the first 10 minutes I recorded her playing *Pharaoh* (see Segment 2.8).

Segment 2.8

Game: The first things this village will need are housing, to provide settlers with a suitable place to live, and a network of roads, to allow its eventual inhabitants to find their way around easily and efficiently.

[Katarina_2005-08-24_first10mins_00:02:03.17]

The game's advice to a new player is to first build housing and Katarina's advice is to build housing after the other main buildings are in place. Her advice is an application of her “design the basics first” approach. Given that the game's advice does not match Katarina's advice or her general method it is worth asking; where did Katarina's advice come from and how did she develop it? When I asked Katarina a variation on those questions she contended that her advice developed over time as she worked through different scenarios and tried different methods of playing the game (see Segment 2.9). Her application of different methods is an adaptive activity.

Segment 2.9

T: Can you tell me a little bit about how you learned those things or where you figured those things out?

K: It's its mostly in the scenarios because that's when I was learning how to play. (T: uhuh). And like I don't know. I was trying different methods of playing and which one works better. (T: mmhmm) And so I found that one to work better.

T: Which one- which one are you talking about?

K: The one with the- where you build the buildings first then build the houses. (T: uhuhh) So it's all ready for the little immigrant people.

[Katarina exit-interview_00:04:44.17]

Katarina's advice and recollection of the “design the basics first” approach development are consistent with recordings I made of her play over several months that I described in the section above. Recall that Katarina did not apply the “design the basics first” approach during some of my observations. Rather she followed the advice given by the game and built housing first. Her statement mentions encountering several chronic snags. Specifically the phrase, “complaints about lack of jobs and um sickness and stuff” is reference to instances when the game tells her that people are unemployed or the population is unhealthy. Her statements in Segments 2.7 and 2.9 then indicate that she uses the “design the basics first” approach to avoid problems in the game and that her use of the approach developed as she tried “different methods”. The making of this routine then is an adaptive activity that is distributed across the player and the snag present in the game.

The chronic snag Katarina encountered developed as she progressed to more difficult scenarios in the game. The game would tell her that her city needs more workers while at the same time it would indicate that there is not enough food to feed the population. From Katarina’s perspective these are competing needs. During the exit

interview I presented Katarina with an image and corresponding video where the game indicated a need for both workers and food (see Figure 2.2). Using *Video Traces* she described the snag as a “pretty big problem” and predicted that the person playing would not be successful at the game (see Segment 2.11).

Segment 2.11

K: And they kind of have a problem. The person who's playing it kind of has a problem because they- the city needs more workers that means that they need to build more houses, but at the same time people already eat more food than they produce. That means like people are kind of starving, or not starving but there's not enough food so there's like kind of a balance if you, what am I doing ((referring to her actions in *Video Traces*)), if you want to make more people. Because the city needs more workers in order for these farms and things and wells to work, but then they have a lot of food, so they kind of- The people kind of need to balance it out between the workers and how many barns there are. And how many working places there are and um. It's locked ((referring to a function on *Video Traces*)). And I think that these people are really, not really likely to win or be successful because, well uh usually this is um needing more workers and eating more food than already produced is usually a pretty big problem.

[Katarina 2006-02-24_img17-1_00:00:30.22]



Figure 2.2: This is an image from the game *Pharaoh* that was shown to Katarina during the exit interview. On the top of the image the game is tell her, “Your city needs more workers” and “People already eat more food than they produce”.

Although there are many issues Katarina encounters while playing *Pharaoh*, I have chosen to focus on the need for more workers and low food snag for the following reasons. (1) Katarina specifically mentioned it in her hypothetical advice to a new player and it differs from the advice the game gives new players. (2) Katarina intentionally broke her routine where she built housing first to address this problem. Although I do not have direct observational evidence that her new practice is stable, she does reference it in advice she would give a new player and described it accurately in a simulated task. (3) Her innovative change in routine- to hold off on building houses- seems to have come from her play of a different yet similar game, *Zoo Tycoon*.

Katarina makes use of the “design the basics first” approach while playing the game *Zoo Tycoon*. In the exit interview I asked her if she had fewer complaints in *Pharaoh* when she did not build housing first. She responded that she did not have those complaints and was then able to make smaller adjustments. I then asked her what advice she would give to someone new to *Zoo Tycoon*. Here she responded that she would give advice similar to her suggestions for *Pharaoh* and then explained a routine that is consistent with the “design the basics first” approach (see Segment 2.12).

Segment 2.12

T: Ok, and so when you do that they have-that there is less of those complaints further on down the game?

K: Yeah and like. like if you have all the buildings first, the people complain less. (T: mmhh). And you can add some things in so its not like, oh you have to go and add like five million doctors or something. (T: hmmm). yep.

T: Ok, and what about Zoo Tycoon? What if somebody wanted to pick up that game?

K: I would say similarly. sim-ah-lar-ly or whatever. um. the same thing as pharaoh. build the exhibits first before you put in the animals. Actually, first I-I-because when you build the cages and you put the animals in the people start coming in and you can't control if the people come in or not. But you-that's only when there are animals at the zoo. (T: hmm) So I usually say like first build the things for the guests, like attractions, besides the animals and food and bathrooms and stuff. And then do the cages. Make the cages and that's when you pu- like make the cages so yo- so it's like when the animals come in they don't have to you don't have like a million from them. (T: mhhm) And so its like you can just change little things instead of having to build a whole new thing. And sometimes when the animals aren't satisfied uhh you're not allowed to adopt more animals which kinda sucks sometimes because sometimes the only reason that they're not satisfied is that they don't have any animals to play with so it sucks when they take away the privilege (T: ohh I see) of adopting animals.

T: Do you have a solution for that? If that ever happens?

K: Restart the game (laughs).

[Katarina 2006-02-24 00:04:44.17]

My observations of Katarina playing *Zoo Tycoon* during the period while she was learning *Pharaoh* support the routine she described in Segment 2.12. Katarina typically added exhibits, a food court, and many other items to the zoo prior to placing animals in the exhibits. Adding animals to the exhibits allows for people to enter the zoo and can create new problems which she is forced to deal with; this is similar to the way that adding housing creates new problems to manage in *Pharaoh*. After she added animals to the exhibits she then consulted with the game's built-in zoo keeper on how to make the environment suitable to the animal. This often involved taking out much of what she had designed into the exhibit after adding the animal.

The development of Katarina's routine while playing the game *Pharaoh* came out of experiences with that game as well as her previous experiences playing the game *Zoo Tycoon*. Katarina's "design the basics first" approach involves making a routine for starting cities and zoos that minimizes the persistent problems she can encounter later in the game. When playing *Pharaoh* a chronic snag formed which she interpreted as problematic (i.e., the need more workers and low food snag). Katarina then took her routines from a similar game, *Zoo Tycoon*, and applied them to this new problem encountered in *Pharaoh*.

Eventually she adopted her routines from *Zoo Tycoon* to overcome the need for more workers and low food snag in *Pharaoh*. When playing *Zoo Tycoon* Katarina waited to place animals in the exhibits until she had built a variety of structures for the zoo's guests. By waiting to place animals she keeps visitors from entering the zoo and holds off on having to handle complaints from them and the animals. In *Pharaoh* Katarina gradually applied this same method to her cities. She applied this method by leaving houses out until other structures were in place. By holding off on building houses people are unable to enter the city and Katarina believes she can avoid problems such as the more workers low food snag.

Recall that my analysis of the making and breaking routines is intended to show adaptive activity as, in part, a function of the socio-technical system. In Katarina's case the socio-technical system includes a variety of media and artifacts as well as her ideas about how to design cities and zoos (i.e. "design the basics first"). The game *Pharaoh's* flexibility was part of the making of her routine, where she began to build houses after

other structures were in place. The game allowed Katarina to use resources, like houses, as she saw fit and so it is flexible. She was able to bring her experiences in another game, *Zoo Tycoon*, to repair a chronic snag because *Pharaoh* was adaptable. The components of the socio-technical system, then, are not only changed by Katarina's actions, but adapted to her application of the "design the basics first" approach.

Vanessa: Material influences on routine activity

This case presents an analysis of two routines taken from my observations of Vanessa's play to understand how the making and breaking of one routine influences the making and breaking of another routine. The first routine is Vanessa's recurrent use of strategy guides across several different games. The second routine involves her use of specific items in the game *Final Fantasy X-2* (FF X-2). The broader story that this case looks at is that when Vanessa began playing FF X-2 she did not have a strategy guide. After several weeks of play and approximately 22 hours of time recorded by the game, Vanessa obtained a strategy guide and restarted the game. In essence her typical routine, playing games with strategy guides, was put on hold and later remade. I use this case to look at how the presence of a strategy guide then influenced her play of a repetitive aspect of the game, which defines the second routine of interest, her use of specific items in the game. The case shows that Vanessa's use of the strategy guide has helped her better understand how aspects of the game work, which in turn led to the adaptive remaking of a routine aspect of the game.

What are the routines?

Using material a resource: A strategy guide

Vanessa's use of external material resources during game play is consistent across a variety of games. She often purchases guides along with the games and makes heavy use of them while playing. Some of her strategy guides are well worn. They have broken spines, missing covers, and tabs that she uses to mark particular sections. Vanessa has told me she takes the guides with her to school. She would often bring them from other locations in her house to where the games are played when our field visits began, indicating to me that she looks at them while she is not playing video games. While reading the guides at school Vanessa takes notes in a three-ring binder to help her remember what she has to do in the game while she plays. In Segment 2.13 Vanessa explained that she uses strategy guides to help her remember goals given by the game.

Segment 2.13

((Vanessa is playing the game The Ultimate Spiderman. She presses the pause button and selects from a menu "city goals". The screen seen in Figure 2.3 comes up.))

V: (mumbles) let's see ummm.

T: what's thi- goals?

V: yeah. Helps me (inaudible) forget- Well usually games don't have that, so I have to buy the strategy guides or I write things down.

[Vanessa 2005-10-20_00:52:08.01]

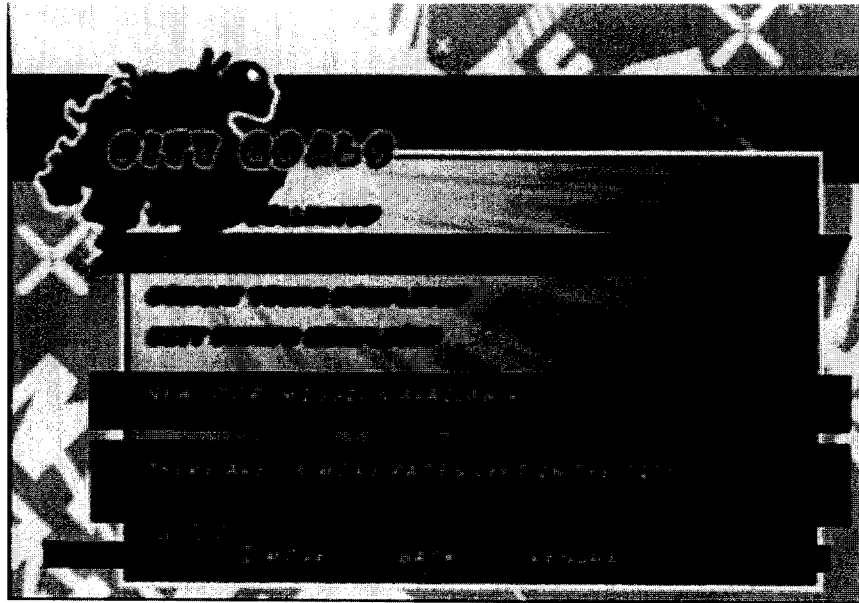


Figure 2.3: This is the screen that Vanessa pulled up while playing The Ultimate Spiderman. When asked about this screen she said she purchases strategy guides when similar content is not available in other games.

Vanessa uses strategy guides as a reference source, turning to them for information on characters and things to accomplish in the game. Through the course of my field visits I saw Vanessa use strategy guides with at least three games (FF X-2, *Kingdom Hearts*, and *The Sims 2*). My conversations with Vanessa indicate that she does not use them as scripts to narrowly direct her play through the game, but rather as sources of information for when she gets “stuck”.

An example of how Vanessa uses strategy guides is present in her play of one specific segment of the game FF X-2, which she encountered before and after she purchased the strategy guide. In this portion of the game her characters walk around a wooded area and sell tickets with the intention of making a profit. The object then was to predict how much people are willing to pay for their tickets, so Vanessa could maximize her profit. When she attempted this without the strategy guide she sold 8 of 10 tickets and

made no profit. Vanessa then encountered the same part of the game when she did have the strategy guide, which listed how much people are willing to pay for their tickets (see Figure 2.4). With the guide as a resource Vanessa sold all of her tickets and made a substantial profit. This is an example of how Vanessa uses the guide as an information source on particular characters in the game.

"YRP, THE SCALPERS THREE!" CUSTOMER BUYING RATES		
MAP LETTER	CUSTOMER	WILL PAY
A	Al Bhed Woman wearing pink near entrance.	Up to 1500 gil
B	Man wearing yellow and brown, standing in grass.	200 gil
C	Woman wearing red headband, before reaching Tobli.	Up to 1500 gil
D	Woman standing beside child, after Tobli.	Up to 1000 gil
E	Woman wearing yellow and orange, standing across from Save Sphere.	Up to 1500 gil
F	Man wearing orange and green, sitting on bench.	Up to 1000 gil
G	Person wearing green sitting on dock stairs.	Up to 1500 gil
H	Person wearing green, standing next to dock.	Any gil amount
I	Child wearing white shirt, standing beside Hypello.	Up to 2000 gil
J	Person in yellow dress, standing at the top of the ramp.	Up to 2000 gil
K	Guard sleeping while standing.	Up to 500 gil
L	Woman in green standing across from bench.	Any gil amount
M	Man wearing blue and yellow, standing on the left side of the path.	Up to 1500 gil
N	Man speaking to elderly woman near entrance to Guadosalam.	Up to 500 gil

Figure 2.4: This table was present in Vanessa's strategy guide for FF X-2. The information in the table tells her where the customer for the ticket is located on a map (left column), a description of the customer (middle column), and how much the customer will pay for the ticket (right column). Vanessa used this table as a checklist while playing a particular part of the game (taken from: BradyGAMES, 2004, p. 123).

Battle routines

FF X-2 is a role-playing game that involves an unfolding narrative based on the adventures of three characters: Yuna, Rikku, and Paine. Throughout this game the player controls the three characters in what are referred to in the gaming world as turn-based battles. Battles are a common element of most computer-based role-playing games (Wikipedia, 2006, Computer role-playing game) and shape much of the "gameplay"¹.

¹ "Gameplay includes all player experiences during the interaction with game systems, especially formal games. Proper use is coupled with reference to 'what the player does'" (Wikipedia, 2006, Gameplay). This should not be confused with "game

The battles in FF X-2 pit the player's characters against one or more enemies referred to as fiends, anions, or bosses.

As an analytical device, I take each battle in FF X-2 to be analogous to a short conversation or interactional moment that repeats in different forms throughout the game. They have a marked beginning, middle, and end; each negotiated by the player and the game. The beginning of a battle is marked with visual and audio effects by the game (see Figure 2.5). An interactional exchange occurs throughout the middle of the battle where the player gives commands for her characters to the game from a large permutation of options. In the next section of this case I will show how the options Vanessa chose changed when she started using the strategy guide. The end of the battle sequence is marked by a screen that displays the statistical results of the battle (see Figure 2.6). During a typical field visit Vanessa would engage her characters in ten to twenty battles per hour. The recurrent activity then is the repetition of several battle sequences throughout a segment of play.

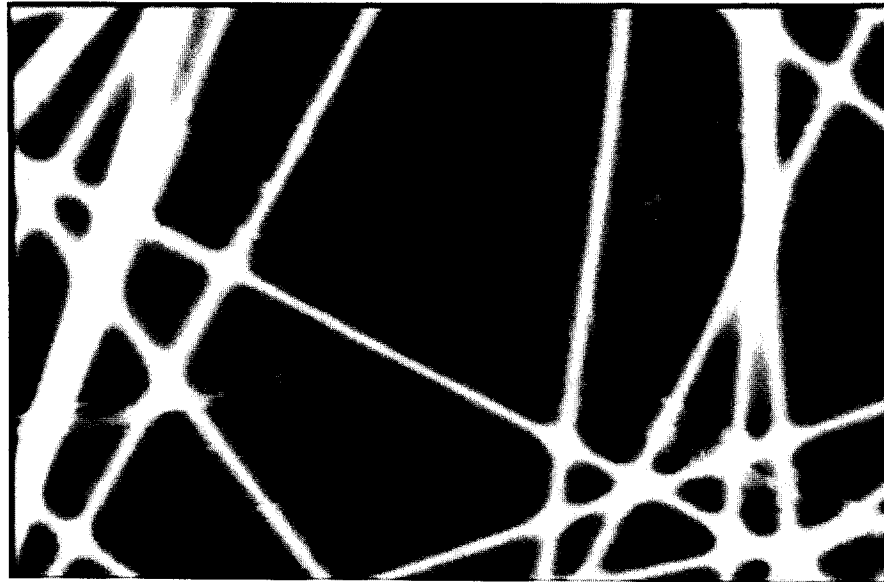


Figure 2.5: The beginning of a battle sequence is marked by an image of the screen breaking into several pieces.

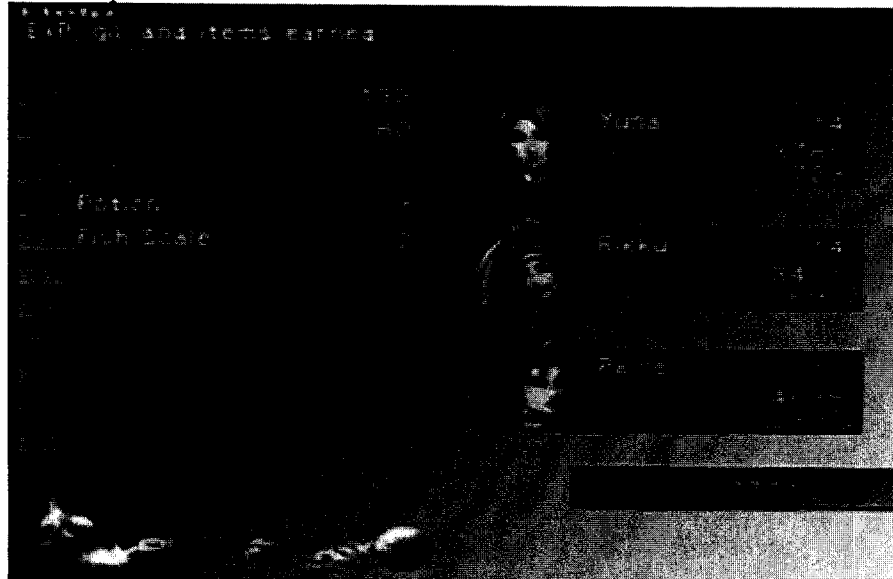


Figure 2.6: A screen shot of the end of a battle where information on the left gives the amount of experience, gil (currency), and items earned in the battle. Information on the right relates to the characters' current status.

Description of making and breaking of the routines

I will now the breaking and remaking of the strategy guide routine and the battle routine.

Making and breaking of the strategy guide routine

The first time Vanessa played FF X-2 during a field visit was the second time I came to her house (2005-08-25). Vanessa then played FF X-2 for the next seven field visits, which were occurring on a weekly basis. She also reported playing the game frequently while I was not there. The hours logged by the game² indicate that she was playing as much as seven hours a week. The second time I saw Vanessa play FF X-2 (2005-09-01) she reported to me that when she purchased the game she could not find a strategy guide for it. In the same conversation she said that she had a strategy guide for another role-playing game, somewhat similar to FF X-2, called “*Kingdom Hearts*” and that she used the strategy guide (along with other resources) when she got stuck in *Kingdom Hearts*. The fifth time I saw Vanessa play FF X-2 she stopped the game after having logged 22 hours of playtime and restarted it from the beginning, this time she had a strategy guide. My field notes from the first occasion when Vanessa had a strategy guide for FF X-2 (2005-09-30) indicate that she told me she was stuck in the game because she did not have enough HP (an indicator of life that raises as the player uses the characters more). After she purchased the strategy guide for FF X-2 I frequently saw her use it while she was playing the game. Often this would involve having the strategy guide open in front of her as she played the game. During pauses in the game she would look at the strategy guide. In other words, Vanessa’s routine of using a strategy guide was broken

² One feature of FF X-2 is that the game keeps track of the total amount of time a saved file has been played. At times Vanessa accesses screens that show the number of hours played. From this screen I can gain a sense of how much Vanessa is playing the game while I am not there.

because the material resource was unavailable and she was unable to continue her play in the same way as if she had the guide. Eventually when she got stuck in the game she repaired the broken routine by purchasing the guide and starting the game over. By doing this she reorganized the socio-technical system to overcome a problem in the game.

Making and breaking of the battle routine

With the introduction of the strategy guide Vanessa changed her battle routine in the game FF X-2 by selecting a different set of options for her characters. As I will show, providing different options for the characters is one way that FF X-2 is flexible. I have grouped the different options available to Vanessa into five categories: only attack, items, change dressphere, special dressphere, and escape. Depending on the difficulty of the enemy she is fighting Vanessa will select an option that fits into one of these categories. For the easiest battles she uses only attacks, which means her characters do not use many of the resources available to them. For battles of medium difficulty, she uses items such as potion along with attacks and dresspheres. Using items and dresspheres changes what her characters can do to better fit the enemy. In more difficult battles she makes use of special dresspheres to make her characters stronger and to provide her with different ways to attack the enemy. In the next chapter titled *Playing with Representations* I present in detail three strategies based on the five categories that Vanessa uses during battles in FF X-2 to show that Vanessa used quantitative representations to develop these strategies. In this chapter I want to show that when Vanessa started using the strategy guide her battle routine changed from one that did not make use of the special dressphere option to one that did make use of this option.

When Vanessa started using the strategy guide her battle routine changed and she began selecting the escape option and special dresspheres more often. The graph in Figure 2.7 breaks down the five categories of options Vanessa chose during the battles I observed. It is divided into two halves, marked by the entrance of the strategy guide when Vanessa restarted the game from the beginning. I want to draw attention to two notable features of this graph, her use of the escape command and the increased use of the special dressphere after she purchased the strategy guide and started the game over.

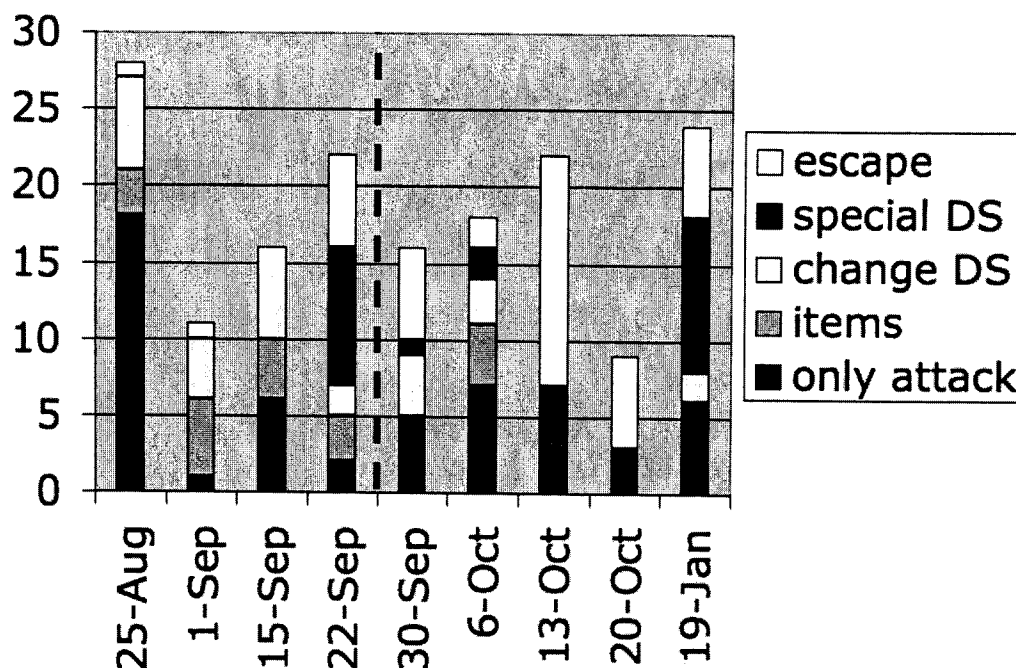


Figure 2.7: This graph is a break down of the strategies that Vanessa used in the battle sequences in FF X-2. The dashed line down the middle represents her restarting the game and purchasing a strategy guide. 25-Aug and 30-Sep are roughly the same point in the game. Comparing these dates shows that when she purchased the strategy guide she started to use the special dressphere earlier in the game.

As Vanessa's play of the game progressed there was an increased frequency in the number of times Vanessa told the characters to escape from battle. When this occurred Vanessa would sometimes say that she did not have time for the battles. She was often

trying to complete other tasks in the game and these battles would get in the way. Her routine in this case was constrained by a factor external to the game, Vanessa's limited playtime.

The graph also shows a change in how much Vanessa used special dresspheres the second time she played the game. The dashed line down the middle marks when Vanessa purchased the strategy guide, and after it she uses special dresspheres earlier in the game. The lines on the graph for 25-Aug and 30-Sep represent similar portions of the game where the difficulty of the enemies is the same. If we compare the two lines we can see that she uses special dresspheres at a point in the game where she did not use them the first time she played it. This represents a breaking and remaking of Vanessa's battle routine. In the next section I will show that her use of the special dressphere shows that she is actively selecting a different set of options based on information she learned from the strategy guide.

How the making and breaking routines happened

The graph in Figure 2.7 indicates that in her second time through the game Vanessa used special dresspheres earlier in the game. This early emergence of that strategy is an indication that the reorganization of her material resources has changed her battle routine. A few field visits after she purchased the strategy guide Vanessa and I had the conversation in Segment 2.14 where she explains what she learned from the strategy guide that helped her use the special dresspheres.

Segment 2.14

T: So did you figure out how to use the special dresspheres first or did you try or did you try it with the--

V: Well, what happened is that when I first, well before I bought this book and stuff I had no. When I said I had special dresspheres I didn't know how to access them and so I talked to Shinra who's over here ((walks character over to a side area on the screen)) and then I read this book and it says other besides using the um. Cause there's there's three- two ways. You can have either one of those big dresspheres- big um big garment grids with more that two nodd ((waves hands in the air)) um. You have to go- you have to use each dressphere to access the special dressphere ((points her had at imaginary nodes in the air several times)). With the other one, which only has two, you only have to go have to go to the other one to use the dressphere ((waves hand between two imaginary nodes in the air)).

[Vanessa 2005-10-13_ 00:16:00.16]

In Segment 2.14 Vanessa describes how her choice of garment grids, an item in the game that is related to dresspheres, impacts her ability to use special dresspheres. By using a smaller garment grid she can more quickly bring up a special dressphere so her characters take less damage from the enemy during the process. More important to this analysis is that she attributes this knowledge to her strategy guide. In other words, Vanessa learned how to more effectively use the special dressphere from the strategy guide. The remaking of her strategy guide routine then is implicated in the making and breaking of the battle routine.

Vanessa's attribution of the strategy guide as the source of her new information may not tell the complete story—there may be other sources influencing her game play. Recordings from the period of time just prior to her purchase of the strategy guide show that she played the game as she indicated the guide told her, using the smaller garment grid to access the special dressphere. Her use of the smaller garment grid before she purchased the strategy guide indicates that she may not have learned to use it from the

guide as her comments in Segment 2.14 indicate. This does not invalidate Vanessa's statement but shows the complexity of the system within which this small piece of knowledge was obtained and used to remake a routine. Vanessa's play of the game and information she read in the guide impacted the development of her practice. In her second time through the game she obtained the two-node garment grid much more quickly than she did in her first time through the game, however she did not always use it to her benefit right away. I recorded her in a battle, after she purchased the strategy guide but before her comment in Segment 2.14, in which she attempted to use special dresspheres with a large garment grid. Her characters died, in part because of the damage they took on while she worked to bring up the special dressphere. My point here has been that Vanessa's use of the strategy guide is implicated in the making and breaking of Vanessa's battle routine, but not the only factor.

Throughout this chapter I have attempted to show adaptive activity as, in part, a function of the socio-technical system. In Vanessa's case by providing the option to select different attacks, use items such as potions, and configure her characters for different strengths the game is flexible. Vanessa used the flexibility in a situation where she did not think the way she was playing the game would allow her to beat it. She adaptively reorganized the entire system that encompassed her play by adding the strategy guide, restarted the game, and played with a different battle routine. The socio-technical system, then, was reorganized when the strategy guide was introduced.

Johnny and Mikey

This case presents an analysis of a fourteen-minute sequence of repetitive action in the game *Super Smash Brothers Melee* (SSBM) played by Johnny (13) and Mikey (15) to show how social interaction and resources in the game are implicated when a routine is made, maintained, and eventually broken. I will begin with a description of the repetitive action that characterizes the routine. From there I will describe the routine's formation to understand what happened when it was made. Next I will describe a moment when the routine was broken and remade along with the events that led to its eventual demise. I will then use other instances gathered from my fieldwork to explain *how* the making and breaking of this routine happened. This case is useful because it shows an instance of a common form their play takes. In it Johnny and Mikey are trying to accomplish something and have set up a routine for trying to achieve their goal. The routine is based on several aspects of the socio-technical system such as a repeatable unit of play in the game, a unique character and move they are trying to use, and the social arrangement of the room.

What is the routine?

Super Smash Brothers Melee is a game in which two or more cartoon-like characters fight each other in battles until they have either run out of time or lives. The player, through specific button and joystick combinations, directly controls a character's

movements on the screen³. While I visited Johnny and Mikey they would commonly play several battles in row, for up to an hour and a half, forming a sequence of repetitive action. Their play of several battles in succession forms the kind of routine I analyze in detail in this case. The battles in this particular instance last between 15 seconds and 1 minute 30 seconds, so the routine repeats rather quickly. SSBM has many different modes of play. Most often Johnny and Mikey either played the “vs. mode”, where they would compete against each other, or they played the “events mode”, where one player would work through a series of scripted challenges called events. The fourteen-minute sequence analyzed here is taken from their play of the single player events mode. I have selected this particular routine because it is an instance where Johnny and Mikey are attempting to use a particular move and involves a character they have chosen to defeat one of the scripted challenges for the first time. The instance then shows the adaptive organization of resources in the socio-technical system to achieve their goal of beating the challenge.

The routine involves 18 repetitive attempts to beat a particular challenge called “Majora’s Mask” in the single player events mode. The routine is characterized by the repeated play of the event within a span of fourteen minutes. Although repetitious, the attempts differ slightly each time as Johnny and Mikey try to use a particular move in order to beat the event. The attempts end in one of two ways, either the game tells the player he has lost by flashing “failed” on the screen or the player uses a command to

³ *The second case in this chapter is based on play of a game where this is not the case. In battle sequences in the game Final Fantasy X-2 the player selects commands from a menu.*

restart the match. In the chapter titled “*Playing with Representations*” I show that Johnny and Mikey use quantities in the game to determine when to restart the match. What follows, in Table 2.1, is a log of the repetitive attempts at the Majora’s Mask event. This table shows the logged time for when the event started, the player controlling the character at that time, how the event ended, and the duration between the beginning of one attempt and the next. The table makes clear that the event was repeated several times. It was not always the case that Johnny and Mikey made repeated attempts of the same challenge; their play in the events mode would take other forms. However it was a routine they commonly used when attempting to beat a specific challenge.

Table 2.1: A listing of the repeated action during a segment of game play. Shown here are the times when the event started, the player controlling the character on the screen, how the event was ended, and the duration of time each cycle lasted.

Attempt #	Time Started	Player	Ending	Duration
1.	3:27.20	Mikey	restart	55.1
2.	4:22.28	Mikey	restart	45.8
3.	5:08.08	Mikey	failure	1:27.0
4.	6:35.10	Johnny	restart	33.9
5.	7:09.00	Johnny	failure	42.3
6.	7:51.25	Johnny	restart	36.8
7.	8:28.08	Johnny	failure	1:29.2
8.	9:57.29	Johnny	restart	1:24.9
9.	11:22.15	Johnny	restart	55.1
10.	12:17.22	Johnny	restart	43.9
11.	13:01.15	Johnny	restart	40.0
12.	13:41.17	Johnny	restart	13.9
13.	13:55.08	Johnny	restart	20.2
14.	14:15.27	Johnny	failure	1:20.8
15.	15:36.06	Johnny	restart	18.0
16.	15:54.10	Johnny	restart	18.0
17.	16:12.07	Johnny	restart	15.1
18.	16:27.17	Johnny	Failure	1:07.0
Ended	17:34.21			

Across these fourteen-minutes there are several attempts at the Majora's Mask challenge that form a routine. In the next section I will use some key moments in this segment to illuminate the social mechanisms that keep the routine together. These instances are organized into two parts. The first part, titled "description of the routine's making", describes the moments leading up to the fourteen-minute sequence of repeated actions where Mikey suggested a change in their play to beat the Majora's Mask challenge. The second section, titled "breaking and remaking", describes two moments. In one moment the in-room aspect of the routine shifted and Johnny took over controlling the in-game action. The shift from Mikey to Johnny is an instance where the routine may have been broken, however it continued and as Table 2.1 indicates stabilized for an extended period. The other moment I describe is the breaking of the routine when Johnny and Mikey moved onto playing a different mode of the game and gave up on trying to defeat the Majora's Mask challenge. In both instances I describe the interactional process between Johnny, Mikey, and the game that either makes or breaks the routine. The section that follows these descriptions will analyze how the interactional process maintains the routine. This case shows the making and breaking of the routine as distributed across the two players and the game.

Description of the routine's making

In this section I will describe the interactions between Mikey, Johnny, and the game that led to the initial formation of the routine shown in Table 2.1. My description will intermix transcripts taken from my video recording with my own description of the

routine's making based on the video. I have broken the transcript up into seven continuous segments (marked Segments 2.15-1 through 2.15-7) that represent approximately two minutes of interaction prior to the routine's first iteration. The description follows the chronological unfolding of the routine's making. My intention here is to provide a *description* of the events leading up to the routine before I begin a full analysis of *how* the routine was made. The description should make clear that Johnny and Mikey had some disagreement about which event on the menu list is the one Mikey wanted to beat, an indication that the game's flexibility is used to make the routine. It begins with a statement by Mikey that ended another series of repeated actions and ends with the first selection of the Majora's Mask event. Mikey's initial statement that broke one series of repeated actions while beginning the set shown in Table 2.1 above is transcribed in Segment 2.15-1.

Segment 2.15-1

M: Hold on Johnny can I do one thing?=
 ((The screen is at an stage in between battles in the vs. mode where the players select new characters. There is a hand on the screen that Mikey controls, it moves to the top right corner where a 'back' button is displayed. He selects it and the 'main menu' comes up.))

M: =I need to do something. I just figured out this last night. Uh. na. yeah. that's it.

M: =I need to do something. I just figured out this last night. Uh. na. yeah. that's it.

((The event mode is selected and a list of events is displayed, see Figure 2.8.))

[Johnny and Mikey 2005-09-16_00:01:13.08]

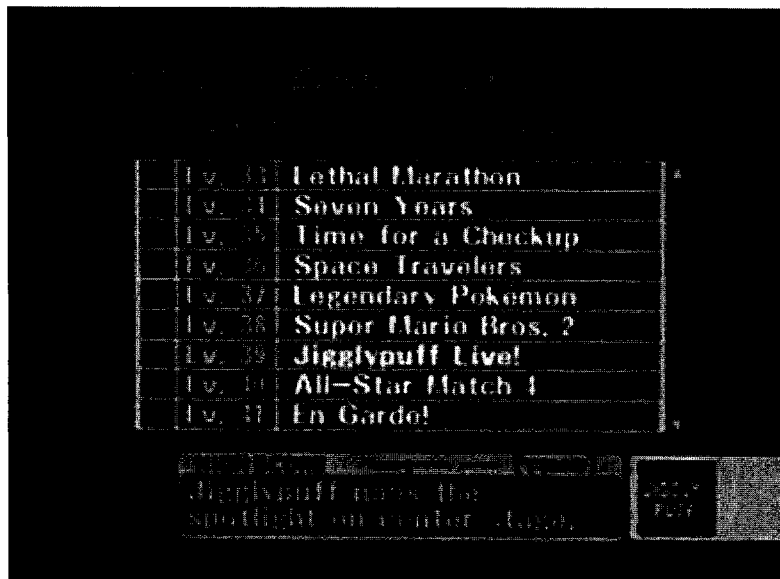


Figure 2.8: The list of challenges in the events mode. Notice the ordinal descriptions (which are rarely referred to) and the title of the events. Dots in the left column indicate events Johnny has completed, also keep in mind the events are not done in the order specified by the game.

In Segment 2.15-1 Mikey called for a shift in action and claimed that he figured something out the night before. In Segment 2.15-2, which occurred right after Segment 2.15-1, we see that Mikey has claimed to have figured out how to beat the Majora's Mask challenge. His claim sets up a reason for making a routine. Mikey also asked in Segment 2.15-2 where to find the challenge on the list of events (see Figure 2.8) present on the screen. Johnny responded by saying that he will get to it.

Segment 2.15-2

M: Where's that Majora's Mask one?

((The screen shows the event match list and the items are scrolled through from the top.))

M: I know how to beat it, I can so:: kill it.

J: Here, I'll get to it.

[Johnny and Mikey 2005-09-16_00:01:27.29]

In Segment 2.15-3 we see Johnny told Mikey to push the A-button on the controller. Mikey agreed, pushed the A-button, which set him up to control the character

on the screen during the battle. It also selects the event that is highlighted on the list at that point.

Segment 2.15-3

(5 sec.)

J: Push 'A' Mikey.

M: all right-

[Johnny and Mikey 2005-09-16_00:01:27.29]

In Segment 2.15-4 a snag emerged in setting up the routine. Johnny declared that the event selected in Segment 2.15-3 is “not the right one” then told Mikey to “push back” so he will return to the main menu. Mikey agreed and the snag was repaired.

Segment 2.15-4

J: -oh, that's not the right one.

((Event #49, "All-Star Match Deluxe" is selected and the character selection screen comes up. Jigglypuff is the selected character.))

M: Jigglypuff! (singing) What?

J: Push back, that's not the right one.

((Mikey's controller goes to the top of the screen and selects the back button.))

M: oh, that's not it.

[Johnny and Mikey 2005-09-16_00:01:27.29]

After the event in Segment 2.15-4 was unselected Mikey and Johnny went back to the menu screen and attempted to find the correct event. In Segment 2.15-5 we see that Johnny selected a different event, however Mikey declared that the new one Johnny selected was also not correct. After going back to the menu screen Johnny told Mikey to trust him and selected the event that Mikey said was not the one he wanted to beat. Johnny then said that if it is wrong he would “whoop” them and started the event despite Mikey’s objection. At the end of Segment 2.15-5 we see that when the event Johnny selected did start he recognized that it was not the Majora’s Mask event, the reiterated

that he would “whoop ‘em”. This segment points to some of the flexibility in the game for setting routines in place.

Segment 2.15-5

((The screen scrolls up to #40, "All-Star Match 4" and it is selected.))

J: All star (mumbles)

M: That's not it!

J: it is.

M: No it isn't. It said, 'want a chance at Majora's Mask. That's what it said.

((The screen is on character selection, Johnny's controller goes to the top of the screen and presses the back button. The screen returns to the events list. The screen scrolls up slowly.))

J: Trust me Mikey, it's all star match 4.

((All Star Match 4 is selected and the character selection screen comes up.))

M: all right. yup, you pressed the wron-

J: See I'll even show you.

((The character Kirby is selected.))

J: and I'll whoop them too if it's wrong.

((The battle screen comes up and the setting does not have Majora's Mask in it.))

J: yep I'll whoop 'em.

[Johnny and Mikey 2005-09-16_00:01:27.29]

In Segment 2.15-6 Johnny began the event, which is not the Majora's Mask event referred to in Segment 2.15-5. Mikey said that he needed to do the Majora's Mask event and that he knew how to kill all of the other characters with one move. Johnny replied to Mikey's claim that he will be able to kill everybody with one hit by suggesting that it might not work. Mikey then provided more information on how he planned to use the move. Johnny quit the event he was working on and returned to the menu screen where events are selected.

Segment 2.15-6

((A battle begins on the screen. Johnny is controlling a character on the screen and fighting a computer controlled character.))

M: I need to do that Majora's Mask one cause I know how to kill EVERYbody in one hit. (2 sec) Jigglypuff! (singing)

J: They wake up to fast=

M: =No you don't even need to make 'em sleep you just get right in the middle of all of 'em and you'll kill at least one with a sleepy attack.

((Johnny switches the game back to the events menu screen.))

J: Let me find it then.

[Johnny and Mikey 2005-09-16_00:02:26.11]

In Segment 2.15-7 Johnny and Mikey find the Majora's Mask event, but it is not called Majora's Mask on the screen rather it is called "Trophy Tussle 3". Leading up to the selection of the event the two boys had further disagreement about which event was the one Mikey was looking for. At the beginning of Segment 2.15-7 Johnny suggested that Mikey do a different event that involves the character Jigglypuff, however Mikey quickly rejected that offer.

Segment 2.15-7

((The screen scrolls up to #39, "Jigglypuff Live!))

J: Here, do Jigglypuff then.

M: no no, not Jigglypuff live.

((The screen scrolls up to the lower numbered events.))

J: you're going too far down.

((The screen starts scrolling back to the higher numbered events.))

M: Hold on.

J: It's trophy tussle

M: trophy tussle?

J: All star match. There it is!

M: Ha Ha!

(("Trophy Tussle 3", number 47 is selected. The description says, "Want a new trophy? Here's your shot at Majora's Mask."))

[Johnny and Mikey 2005-09-16_00:02:26.11]

Taken as a whole Segments 2.15-1 through 2.15-7 indicate that making the routine involved several steps. First Mikey initiated a switch in activity by suggesting that

he was able to beat the Majora's Mask event with a move he learned the night before. Then Johnny and Mikey searched for the event using the menu shown in Figure 2.8. Their first selections turned out to be incorrect. The boys realized their selections were incorrect and repaired the situation by returning to the menu where they eventually found the correct event and began the repetitious sequence shown in Table 2.1. The back and forth displayed in Segments 2.15-1 through 2.15-7 shows the game as adaptive in that Johnny and Mikey intentionally select a challenge from a list of fifty.

The sequence of repeated actions is maintained by interactions between the boys and the game. For example, a unique aspect of Johnny's play is his use of the reset command. Johnny uses this button to restart an event when he thinks he is not going to defeat it. The pattern, represented by Table 2.1, is typical of how Johnny works on challenges in the events mode. An event is selected and then several attempts to complete it are made, Table 2.1 shows 18 attempts made during this particular sitting. These attempts continue until one of the following occurs: the event is completed, he moves onto a different event (without completing the previous one), he plays the versus mode with Maddy (their sister) and/or Mikey, he plays a different game, or he stops playing video games all together.

Breaking and remaking

In this section I will describe two instances of routine breaking. In one instance the routine is remade however a different player is in control of the character on the screen. The other instance is the final breaking of the routine shown in Table 2.1. In both

instances Johnny and Mikey use the end of a battle as an opportunity to make and break the routine.

After three recurrent episodes where Mikey unsuccessfully attempted to beat the event Johnny took over (see attempt 4 in Table 2.1). I will use transcripts from the video recording seen in Segments 2.16-1 through 2.16-3 to describe the process where play of the game shifted from Mikey to Johnny. I consider this moment a breaking of the routine since one aspect of it (the player) changed, however the play continued in much the same way so I also consider it a remaking of the routine.

When Segment 2.16-1 began Mikey was using the character Jigglypuff in the second iteration of the routine (see Table 2.1, attempt 2). A moment came when Mikey used Jigglypuff as he intended and all of the characters flew off the screen. Mikey then let out a yell, “DOOOH YEAH!” and Johnny made an inaudible comment. I suspect Johnny’s comment has to do with the fact that only one of Mikey’s characters lost a life after that move. Soon after that Mikey restarted the game, which puts them into the third iteration of the routine. Johnny used the break in play caused by the restart to ask for a turn, but Mikey continued playing. Johnny complained, “that’s not fair” and Mikey responded that Johnny played the game “all the time.”

Segment 2.16-1

((Mikey is using the character Jigglypuff to beat the Majora's Mask event. All of the characters are crowded together on the screen. Suddenly Mikey's character knocks a bunch of them off.))

M: DOOOH YEAH!

J: (inaudible??)

((Mikey's character Jigglypuff drops down from the top of the screen.))

M: ahh!

((Mikey restarts the game before the event is over.))

J: Here, let me try Mikey.

((Mikey starts another attempt at the event.))

J: That's not fair.

M: You play this game all the time=

J: =no I don't=

M: =and I never do=

[Johnny and Mikey 2005-09-16_00:04:56.15]

Segment 2.16-2, which picks up three seconds after Segment 2.16-1 ends, represents a somewhat longer time period. Throughout Segment 2.16-2 Mikey made several statements that indicate he was having trouble beating the event; “This totally stinks they keep putting shells right in the middle”; “why isn’t it working”. At the end of Segment 2.16-2 “failure” was written on the screen at the end of the third attempt. Throughout this discussion Mikey continued to play the game maintaining the routine.

Segment 2.16-2

(3 sec.)

M: whoa. (3 sec) I think I'll just stay up here while he's invincible.

((Jigglypuff is floating up at the top of the screen.))

J: you only have five jumps and then you're-

(13 sec.)

M: Jigglypuff needs a brick move.

(23 sec.)

M: This totally stinks they keep putting shells right in the middle.

(6 sec.)

M: why isn't it working.

(4 sec.)

((Mikey pauses the game.))

J: Mikey.

M: press Z.

((Failure comes up on the screen.))

[Johnny and Mikey 2005-09-16_00:05:17.07]

Segment 2.16-3 picks up where Segment 2.16-2 left off. "Failure" had appeared on the screen. The difference in the iteration shown in 16-3 is that Johnny had taken over controlling the character on the screen. When Segment 2.16-3 ended Mikey had once again stated that the move did not work, "it just doesn't work", but Johnny responded that he was using the character Jigglypuff incorrectly.

Segment 2.16-3

((Mikey gets a "failure". The game screen returns to the events menu. The same event is selected; Johnny is now controlling the action on the screen.))

M: It just doesn't work.

J: That's because you weren't doing the right moves.

M: Yeah I was=

J: =Mikey you were only doing down B. She's got more moves than down B.

[Johnny and Mikey 2005-09-16_00:06:26.14]

Johnny then went on to try the challenge for nearly 10 minutes and several iterations that make up the bulk of the routine shown in Table 2.1. He continued until Mikey said that he was no longer interested in continuing and asked for a return to their previous activity of playing the vs. mode against each other. Segment 2.17 shows the

transcript of the eventual breaking of the routine, including Mikey's request and Johnny's response. Segment 2.17 begins when Johnny gets a failure from the game. At the same moment Mikey sat up and asked Johnny to play with him rather than continue playing the single player events mode. Johnny agreed although his response was not enthusiastic. In both instances (Segment 2.16-1 through 16-3 and Segment 2.17) Johnny and Mikey are using pauses in the game play caused by the end of a battle as an opportunity to make or break the routine.

Segment 2.17

((Johnny gets a "failure" on the screen.))

(Mikey, who was sitting crouched over with his head resting in his hands, sits up.)

J: Oh, I thought that was my=

M: =come on, play with me.

J: oh fine.

((Screen goes back to main menu and the vs. mode is selected.))

[Johnny and Mikey 2005-09-16_00:17:25.27]

I used two moments in this section (Segment 2.16-1 through 16-3 and Segment 2.17) to described breakdowns in the routine shown in Table 2.1. The breakdown in Segments 2.16-1 to 2.16-3 was repaired and the routine of repeated attempts at the Majora's Mask event continued. The other break (Segment 2.17) ended the routine and lead into the formation of different yet similar routine when the boys played the vs. mode of the game. In both instances the boys took advantage of pauses in the game play to either end the routine or find a way to continue it. In the next section I will use the descriptions I have provided thus far of the routines making and breaking along with other instances of their play in an analysis of *how* the making and breaking of this routine was an adaptive activity distributed across the socio-technical system.

How is the routine made and broken

My analysis of how the routine shown in Table 2.1 was made and broken expands beyond a mental explanation of the routine to include its material and social components. Several elements of the socio-technical system play a role in the adaptive activity present in the making and breaking of this routine. These elements are both social and technical.

Doing it right as a reason to start and keep going [selecting commands, assembling resources]

In this section I will explain how two in-game resources became a part of the routine shown in Table 2.1. These resources are what Johnny and Mikey are attempting to use to beat the challenge and so they are a part of the adaptive activity. The resources of interest here are the character Jigglypuff's special attacks. One of these moves, "rest" is recognized in the gaming community as a powerful attack in SSBM.

Rest (Down+B) - The most powerful non-charge attack in *Smash* games so far, but very difficult to connect. Sends opponents flying off the screen at 40%+, while Jigglypuff goes to sleep for four seconds unless hit by an attack. Jigglypuff sleeps whether the attack connects or not (Wikipedia 2006; Jigglypuff).

The other attack is "sing" is directly referenced in Mikey's bid to play the Majora's Mask event. "Sing (Up+B) - Puts opponents to sleep to make them vulnerable" (Wikipedia 2006; Jigglypuff). I have recopied Segment 2.15-6 below to show how the sing attack played a role in making the routine shown in Table 2.1. Recall that in Segment 2.15-6 Johnny had begun work on a challenge that is not the Majora's Mask one that Mikey had indicated he could beat. Soon after Johnny began the challenge Mikey said, "I need to do that Majora's Mask one cause I know how to kill EVERYbody in one

hit. (2 sec) Jigglypuff! (singing).” By singing “Jigglypuff” Mikey is referencing the sing attack, which occurs in the game as Jigglypuff sings its own name. Johnny then challenges Mikey’s suggestion by claiming that when the singing attack is used, the other characters “wake up too fast.” Mikey’s response is that the other characters do not need to be asleep for the attack to work, “you’ll kill at least one with a sleepy attack.” Here Mikey is claiming that he can use the ‘rest’ attack to kill at least one of the enemies. Johnny then ended the challenge he was working on and went to find the Majora’s Mask challenge. Their debate about whether or not the attack will work speaks to the flexible nature of the game.

Segment 2.15-6

((A battle begins on the screen. Johnny is controlling a character on the screen and fighting a computer controlled character.))

M: I need to do that Majora's Mask one cause I know how to kill EVEverybody in one hit. (2 sec) Jigglypuff! (singing)

J: They wake up too fast=

M: =No you don't even need to make 'em sleep you just get right in the middle of all of 'em and you'll kill at least one with a sleepy attack.

((Johnny switches the game back to the events menu screen.))

J: Let me find it then.

[Johnny and Mikey 2005-09-16_00:02:26.11]

The rest attack is an in-game resource that is as much a part of the recurrent action as any other factor present in the situation. It is the reason why the recurrent action that was in place prior to Segment 2.15-1 was broken. Mikey’s claim that he could use the rest attack to beat the Majora’s Mask event, a challenge that had not been beaten, set up specific conditions for the routine. Those conditions included but are not limited to using Jigglypuff and the rest attack to beat the Majora’s Mask event. The specifics of *how* the rest attack is best used were left unsettled at the end of the recurrent action in Table 2.1.

Character knowledge [a mobilized resource]

Use of specific characters can also be a factor in setting up recurrent action. The routine shown in Table 2.1 is built around use of the character Jigglypuff. It is not uncommon while working on challenges in the events mode for Johnny to continually use the same character. Recall Segment 2.16-3 (recopied below) where Mikey claims that the rest attack is not working, “it just doesn’t work.” Johnny replied that Mikey was not doing the right moves then told him that Jigglypuff has more than “down B” (the rest attack). What is present here is working knowledge of a specific character that is becoming part of a recurrent activity.

Segment 2.16-3

((Mikey gets a "failure". The game screen returns to the events menu. The same event is selected; Johnny is now controlling the action on the screen.))

M: It just doesn't work.

J: That's because you weren't doing the right moves.

M: Yeah I was=

J: =Mikey you were only doing down B. She's got more moves than down B.

[Johnny and Mikey 2005-09-16_00:06:26.14]

The use of specific characters is a part of many different routines in Johnny and Mikey’s play of SSBM and so this aspect of recurrent activity in Table 2.1 is not uncommon. Segment 2.19 is an example taken from another field visit that shows how selecting characters in the vs mode sets up a specific context for the kids play. In Segment 2.19 Johnny, Mikey, and Maddy are all fighting against each other in a battle. Johnny has lost and blames his loss on the type of characters Mikey and Maddy are using. He then suggests that they all use the same type of character in the next battle. Mikey and Maddy agree to this and specific characters are selected. I have added this segment to show that building a battle around a character, as Johnny and Mikey did in

Table 2.1, happens at other times during their play. The option to choose from a range of characters is one way the game is flexible and contributes to the adaptive activity that surrounds its play.

Segment 2.19

((Johnny, Mikey (Mi), and Maddy (Ma) are all in a battle fighting each other. Johnny's character is knocked off the screen leaving him out for the rest of the battle.))

J: You stupid sword people. You know I'm going to be sword person
next=

Ma: =I'm being Marth=

J: =let's have a=

Ma: =I'm pretty good with Marth hun.

J: =all sword battle.

Ma: nobody else be Marth please. I like Marth.

((A few seconds later the battle ends. Johnny moves his pointer up to select a character named Roy that comes with a sword. The other two leave their character selections the same, they all have characters with swords. Next, they move onto selecting a stage.))

Mi: Jungle Japes again.

J: yeah, that's a good sword place.

Ma: ahuh.

((Battle begins))

[Johnny and Mikey 2005-07-14_01:23:13.16]

Battles as a repeatable unit [an assembled resource]

The repeatable unit in the routine described here is the Majora's Mask event. As Table 2.1 indicates this unit repeated several times over within a span of fourteen minutes. Also consider the trouble that Johnny and Mikey went through to find and use the Majora's Mask event (as shown in Segments 2.15-1 through 2.15-7). Generally speaking their play of SSBM can be characterized as a span of repeating battles whether they are playing the events mode or the vs. mode. In other words the routine in Table 2.1

is possible because the game has a unit that can be repeated several times over. This distributes the routine, and its making and breaking, across the players and the game.

Owning the game [a mobilized resource]

Another factor in routine making is related to the ownership of the SSBM game. Even though SSBM was the game Johnny and Mikey played the most during my field visits the game is more accurately described as belonging to Johnny. For instance, Johnny took control of the mouse during a portion of the exit interview where they were asked to make annotations over images from SSBM. Johnny also frequently played the game without Mikey, however I rarely saw Mikey play the game without Johnny. In the following instance (see Segment 2.20) Johnny and Mikey are setting up the game to play a specific mode. Both of their controllers are active on the screen. This leads to a moment where the game receives an unintended command and Johnny uses his ownership of the game to take control of the activity on the screen, "Mikey, you stop, my game."

Segment 2.20

J: Hey want to do one of those giant tournaments?

M: Yeah

((Character selection screen comes up. Johnny and Mikey both direct their pointer to the "back" button on the screen. Mikey reaches it first, he selects it and the game goes back to the main menu.))

M: Not a super giant one. Where is it?

((The screen has five menu items that are scrolled through quickly. "Melee" is selected. See Figure 2.10)))

M: you stop.

J: Mikey, you stop. my game.

((Johnny's controller goes up to the back button and selects it. The screen goes back to the previous menu and "Tournament Melee" is selected.))

[Johnny and Mikey 2005-09-02_tape1_00:18:22.18]

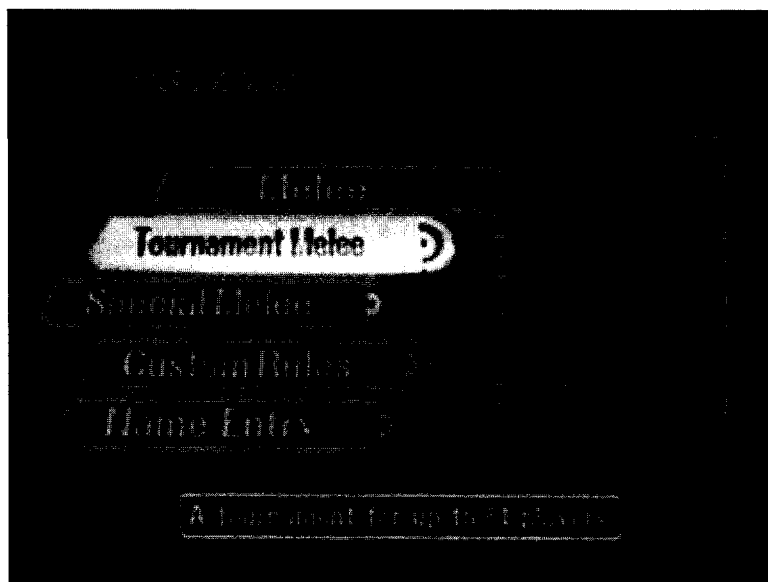


Figure 2.10: The main menu screen in SSBM. This is where Johnny and Mikey selected the tournament mentioned in the above instance.

I have brought in the instance in Segment 2.20 because it is an example of a question that is potentially raised by looking at the routine in Table 2.1. If using Jigglypuff's rest attack to beat the Majora's Mask challenge was Mikey's idea then why did Johnny have control over the game for most of the recurrent activity. My answer is that the game, in addition to the record of completed events stored on the memory card, belongs to Johnny and is therefore his project on which to work. Mikey was, in a sense, trying to help Johnny complete a list of challenges which comprise his project.

Breaking up with boredom [the integration of social, cognitive, and material factors]

So far I have described several factors important in making the routine in Table 2.1. I will conclude my analysis of SSBM for this chapter with a factor that I think was rather important in breaking the routine in Table 2.1 as well as important in other gaming routines. Recall from Segment 2.17 (recopied below) that the recurrent activity did not

end with successful completion of the event, instead Mikey asked Johnny to play with him. Mikey's request was in reference to switching play to the vs. mode of the game. His body positioning at the time along with the tone of his voice indicate that he was less interested in continuing the routine than Johnny may have been. Also consider Johnny's response, "oh fine", indicating as well that he did not want to break the routine.

Segment 2.17

((Johnny gets a "failure" on the screen.))

(Mikey, who was sitting crouched over with his head resting in his hands, sits up.)

J: Oh, I thought that was my=

M: =come on, play with me.

J: oh fine.

((Screen goes back to main menu and the vs. mode is selected.))

[Johnny and Mikey 2005-09-16_00:17:25.27]

Boredom as a factor in making and breaking routines is present across other games Mikey plays. In Segment 2.21 I have transcribed a discussion between Mikey and me on the game *Kingdom Hearts*. Our discussion began when I asked him about the gameplay in *Kingdom Hearts*. Mikey went on to explain that he liked this particular game in comparison to others because the battles were not as "tedious" and "repetitive". During another field visit he stopped playing a game called "*Tales of Symphonia*" because it involved a long segment of dialog between characters in the game.

Segment 2.21

T: So, what were you saying about the gameplay on this one?

M: Um, it's more action based rather than waiting your turn and everything.

T: unhuh.

M: You'll see in a minute.

T: and so why do you think that makes it better?

M: Because- just uh- leveling up in the old one, you'd have to be like level 100 to beat the final boss always.

T: ahuh

M: But that would take so long. It'd be tedious and kind of repetitive but even in this one, even though you are fighting the same enemies for over half the game, just in different outfits, they:: its really fun.

T: mmhum

M: So you don't mind getting up to level hundred and I'm already on level ninety on my main file.

T: On your main file?

M: yeah.

T: even though you've beaten the game?

M: yeah, I kept on leveling up so I- because there's a bonus boss who's- unless you are incredibly strong and skilled

T: unhuh

M: You- you couldn't beat him. His name is Sephiroth. He's from one of the old Final Fantasy games.

[Johnny and Mikey 2005-12-09_00:00:45.23]

My purpose in this chapter has been to show adaptive activity as, in part, a function of the socio-technical system. In this case, the socio-technical system that encompasses Johnny and Mikey's play adapted in several ways. The game provided a set of resources that reacted to Johnny and Mikey's use of the character Jigglypuff and the rest attack. The system as whole also adapted to the changing conditions in the social context. Mikey became bored watching Johnny play and so the system adapted to his request. The adaptive activity then is distributed across people and artifacts.

Conclusion

I will conclude this chapter by returning to the concept of adaptive expertise (Hatano & Inagaki, 1986) to consider insights these cases provide for understanding adaptive activity as a function of the socio-technical system where the game play took place. In each case one or more routines were made and broken. My contention is that making and breaking routines involves “flexible, innovative, and creative competencies” (Hatano & Oura, 2003, p. 28) that characterize adaptive expertise. However these “competencies” extend beyond the individual and include other aspects of the socio-technical system (Pea, 1993).

Expertise is a concept that is based on the relationship between individuals and it is dependent on the context in which the expert activity takes place (Stevens & Hall, 1998). It becomes problematic when we ask questions about to whom and in what situations is an individual an expert. For this reason I want to separate the terms adaptive and expertise in order to better explain the making and breaking of routines. In doing this I hope to move beyond the notion that adaptive activity is a function of the individual. I also want to build on Hutchins’ definition of learning as “adaptive reorganization in a complex system” (Hutchins, 1995a, p. 289) by asking how a particular socio-technical system is adaptive.

The situations that I observed and described above provided many resources for the participants to make and break routines, so the socio-technical systems are quite adaptive. For instance, Katarina, who played *Pharaoh* and *Zoo Tycoon*, had a host of options for how she could build her cities and zoos. The making of her routine in

Pharaoh, where she began to build houses after other structures were in place, was based in part on the game's flexibility. The game was flexible in that it allowed her to use resources, like houses, as she saw fit. Because the game was adaptable she was able to bring her experiences in another game, *Zoo Tycoon*, to repair a chronic snag. In Vanessa's case the game allowed her to choose from a large permutation of options while she was fighting a battle. The ability to select different attacks, use items such as potions, and configure her characters for different strengths is what makes the game flexible. Vanessa was in a situation where she did not think the way she was playing the game would allow her to beat it. She then adaptively reorganized the entire system that encompassed her play by adding the strategy guide and restarted the game. There are many aspects of the system that allowed for her reorganization to happen such as the availability of the strategy guide at a retail outlet, the ability to save multiple files on the game system so she could restart and still have her previous play saved, and the number of permutations that allow for a different experience the second time through the game. In Johnny and Mikey's situation the social context was an important factor in their ability to make and break a routine. The selection of Jigglypuff to beat the Majora's Mask challenge is one way that the game is adaptable. Two months after the routine I described above, Johnny did beat the Majora's Mask challenge but he did it without Mikey and without Jigglypuff. In that instance he played alone and used a different character that also has unique attacks. Across all three cases there are different ways that the system as a whole was adaptively reorganized.

I have selected the three cases above because each highlights different components used in the production and maintenance of routines. Johnny and Mikey's case shows how a routine can be assembled through a socially negotiated process. Their routine broke down when Mikey passed the game off to Johnny and additional negotiation was needed. Vanessa's case displays the role a material resource can have in changing and adapting a routine. The context was set up such that the resource could be used to reorganize the entire system. In Katarina's case a routine became problematic and a chronic snag formed; she then used a cognitive resource to adaptively reorganize her routine. Each of the three cases then involves the use of cognitive, social, and material resources in the adaptive reorganization of routines.

Moving the boundary of adaptive activity beyond the individual to include the socio-technical system presents challenges for how to think about assessing learning. Schwartz, Bransford and Sears (in press) have described assessments based on the idea that an optimal learning outcome involves an ability to be innovative and efficient. What is termed preparation for future learning (PFL) assessments then measure one's ability to learn in a new situation and ideally "include opportunities for people to try out hunches, receive feedback, and attempt to revise based on the feedback" (Bransford, Vye, Stevens, et al., to appear). As the examples above show video games are similar to PFL assessments in that players revise their play over time using feedback given by the game along with other social, material, and cognitive resources. The crux is that the socio-technical system that surrounds game play is adaptive and the reorganization extends beyond the player.

I began this chapter by suggesting that I would analyze a notorious quality of video games; their seemingly recurrent activity. Throughout the chapter I have shown how video gaming routines are made and broken through adaptive reorganization in a complex system (i.e learning). Taking Hutchins' (1995a) definition of learning then we have reason to rethink whether or not recurrent activity should be considered a negative aspect of game play or part of the process by which a player learns to play the game.

Chapter III: Playing with Representations: How Do Kids Make Use of Quantitative Representations in Video Games?

There is a history of empirical and conceptual work that explores the relationship between the development of STEM concepts and practices and everyday activities (Vygotsky, 1986; diSessa, 2002; Ochs, Taylor, Rudolph & Smith, 1992; Stevens & Hall, 1998). These studies investigate the ways in which aspects of formal disciplines appear in contexts outside of school. A subset of this work, termed ‘everyday math,’ looks to how quantities are represented and used in everyday contexts (Beach, 1995; de la Rocha, 1986; Lave, 1988; Scribner, 1997; Stevens, 2000). A common finding is that there are significant differences in how people, tools, and concepts are organized between school and everyday life which indicates a need for looking further into how aspects of school appear in everyday life and a need to reorganize how they are taught in school.

This chapter describes how quantitative representations present in video games are used by the participants in this study. Comparison of STEM practices to video game play is not an entirely new line of work; however, the current body of literature exploring this relationship is not substantial. From a psychological standpoint, Greenfield et al. (1994) conducted experiments to test whether or not the inductive skills developed while playing video games transferred to scientific-technical representations. Their findings suggest game playing develops skills for decoding and encoding iconic representations. While their work is provocative, the particular game they used bears little resemblance to the games I observed young people play. Additionally the lab context, in which subjects were studied, limited resources external to the game in ways that my ethnographic observations indicate are significant. In essence, their study suffers from a lack of

ecological validity (Cole, Hood, McDermott, 1978) in that the context of the experiments was constrained to where generalizations to everyday life are less plausible. More recently, Lowrie's (2005) case study of a young boy playing the popular game *Pokémon* showed a range of strategies and engagement with both closed and open ended problems similar to those called for by leading mathematics educators. His study, while also significant, was based off interviews during which the young boy described his knowledge of the game and so does little to understand the boy's emergent practices.

Here I draw on two cases to show that while playing video games our participants use quantities to make calculated decisions and to develop strategies for use in their games. I will begin the chapter with an argument for why analyzing the use of quantitative representations in video games is important. From there I will use Hutchins' (1995a) theory of Distributed Cognition in an analysis of how our participants made use of quantitative representations during their play. The bulk of the chapter focuses on data collected from two of the homes that I visited organized into two cases. The cases have a similar structure in that both contain sections that describe (1) a game frequently played in one of the homes; (2) how the participants playing that game use quantitative representations to balance available resources with what they are trying to accomplish in the game; (3) how quantitative representations are used to develop strategies in the game; and (4) how school-based mathematics finds its way into the game context. The chapter concludes with a discussion where I look across the two cases and consider the implications of my findings for mathematics instruction.

At this point I would like to turn to a brief interaction between myself (T) and a participant (V) that I believe is relevant to an investigation of how quantities are used in game play.

Segment 3.1

1. *V: I'm gonna stop right here.*
 2. *T: You're gonna stop?*
 3. *V: Yep.*
 4. *T: That's it huh?*
 5. *V: I have a headache right now*
 6. *T: Oh, really. from all the battles?*
 7. *V: No school.*
 8. *T: Ohh*
 9. *V: Actually it's more of a math problem.*
 10. *T: At school?*
 11. *V: No in a video game.*
 12. *T: Oh, what's the problem?*
 13. *V: I have to use math in this one too. Or strategy I should say.*
 14. *T: What's the- what's the math you're using?*
 15. *V: Now we're using. I forget what we're learning. I just know that it's algebra. But still it gives me a headache.*
 16. *T: Oh, and you use it in the game?*
 17. *V: Yeah.*
 18. *T: How do you do that?*
 19. *V: Like how much stuff I need to use or what kind of strategies I need to use ((inaudible)). I have it in the game guide. I have a headache right now.*
 20. *T: Hmmm. So that helps you out then, besides giving you a headache? ((laughs))*
 21. *V: No, too much math.*
- (Vanessa 2006-01-19_01:04:10.17)*

The interaction in Segment 3.1 occurred during one of my regular field visits with Vanessa (V). She had been playing the game *Final Fantasy X-2* for approximately one hour when she suddenly stopped and declared that she had a headache. From her statements (c.f. lines 9 to 11) in response to my (T) questions I gather that the headache was from doing math, which she used while playing the game. This short interaction

between Vanessa and me is one of three direct connections that the participants independently made between a STEM (Science, Technology, Engineering, and Mathematics) discipline and video games. If in addition to Vanessa's statement, we consider that the object of many video games is at the very least contingent on achieving something that is expressed in quantitative terms (i.e. a high score or a particular level) then there is reason to believe that the use of quantities is a common part of game play. As a starting point, we might assume that game quantities are displayed while the players eyes and hands are otherwise occupied creating a situation with potential for mental calculations. From an ethnographic perspective this aspect of game play has been relatively understudied as a potentially important connection between young people's everyday experiences and disciplinary practices taught in school (Bransford, Vye, Stevens, et al., to appear). In this chapter I use two cases to understand quantitative representations in the game's interface and how our participants make use of them.

I approach the use of these representations as though it is a quantitative practice (Stevens, 1999). The term 'quantitative practice' is used in reference to how people make use of quantities in their everyday activities. I withhold the terms 'mathematical practice' and 'scientific practice' because of their relation to formal disciplines that live in educational and professional contexts. My withholding the terms mathematical and scientific is not meant to diminish similarities between how quantities are used in everyday life and how they are used in formal disciplines. Rather it is a means to analyze everyday practices without restricting myself to the terms, artifacts, tools, and purposes that surround and make up the formal practices. It is too easy to pass off everyday

experiences as not being real math or science (Palinscar, 1989) based on the components I will describe in this chapter and others have described elsewhere (Beach, 1995; de la Rocha, 1986; Lave, 1988; Scribner, 1997; Stevens, 2000). In a sense I circumvent the question of whether or not what I have observed is math or science as a means to compare practices in the different contexts.

Quantitative practices and video games

My contention is that video games offer fertile ground for exploring the use of quantitative practices in everyday life. To varying degrees most (if not all video games) represent quantitative information to the player in some form (see Figure 3.1). I use the term quantitative representation in reference to the various ways that quantities appear in everyday contexts. Quantities can take many forms such as a graph, a vector or line, or as a digit. As Figure 3.1 indicates video games represent quantities in forms such as digits, bar graphs, and tables. As mentioned above, the object of many video games is contingent on achieving something that is expressed in quantitative terms such as a high score or a particular level. Other examples of how quantitative representations appear can be seen in the number of lives or amount of life a player has left, the amount of capital she has accrued, time, and the velocity of an object on the screen. It has been argued in several places that playing video games can be an intellectually challenging endeavor (Gee, 2003; Johnson, 2005; Sefton-Green, 2004). If this is added to my previous point, that the object of many video games is contingent on achieving something expressed in quantitative terms, then I believe it is likely that players will make use of quantitative representations in decisions that effect their play.

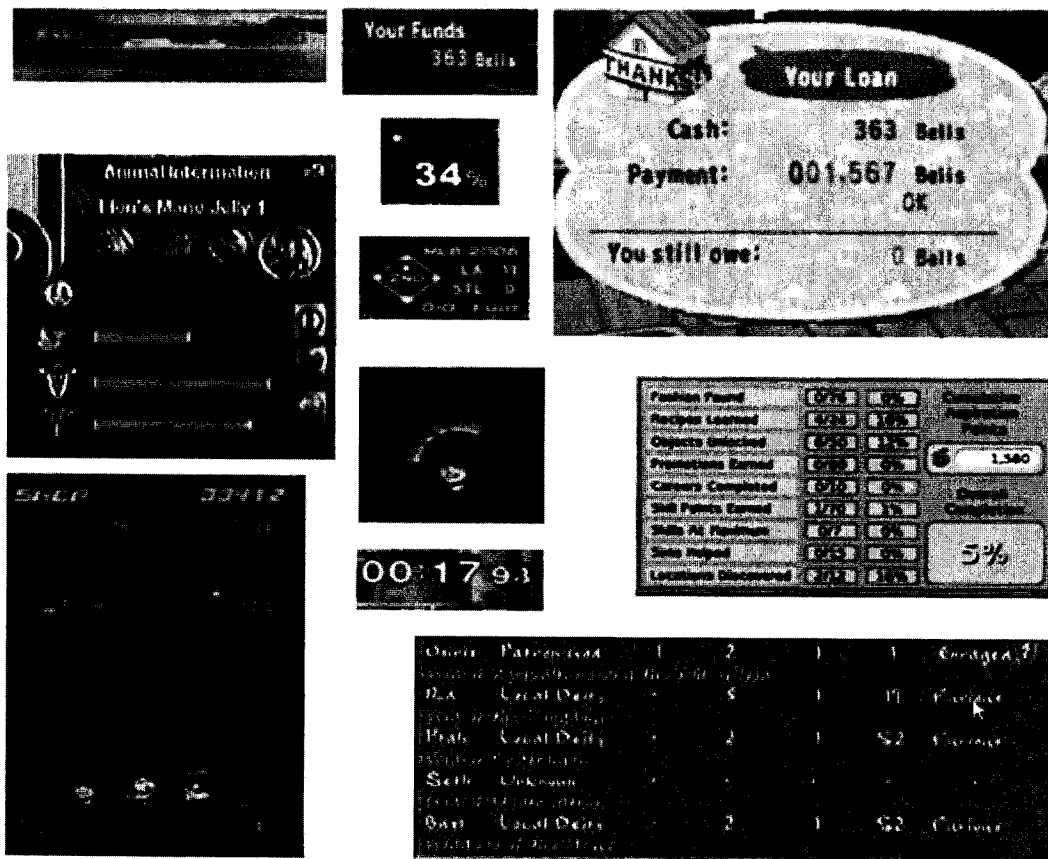


Figure 3.1: Some of the means by which quantities such as time, life, and currency are represented in video games.

As mentioned above, some of our participants have independently drawn a relationship between their video game play and science or math class. In addition to Vanessa's comments in Segment 3.1, the participants independently drew connections on two other occasions. While playing an arcade game from the 1980s called *Phozon*, Mikey mentioned answering a question correctly in science class with knowledge he gained from the game. His comment was unprovoked having come out while I was setting up the recording equipment. In *Phozon* the player collects a clump of atom-like objects called 'atomics' into a 'molek' to match a given pattern. After I set my recording equipment up, I asked Mikey to tell me again what he said about the game (see Segment 3.2).

Segment 3.2

1. M: Ok. Well, I learned a valuable lesson from tha- this game in that was how many bonds a carbon molecule can form- a carbon atom can form, so I was able to answer a question in class when nobody else was.
2. T: What was the question?
3. M: It was, uh, how many bonds can a carbon mol- er carbon atom form. We had to a lab where we built models of it and just remembered this game to.

[Johnny and Mikey 2006-09-30_00:00:15.15]

Vanessa has described similarities between a mini-game in *Final Fantasy X-2* called “Sphere Break” and an assignment in her math class. The mini-game Sphere Break involves combining quantities to find multiples of a given number. This particular conversation on Sphere Break occurred as I was packing up the recording equipment. She asked me about my work at the university and I commented that I studied video games because of my interests in learning and technology. She said that it made sense that I studied video games and then went on to describe how she had thought about the mini-game during an in-class math activity at school. She also reported that she used paper and pencil to find multiples while playing the game at home. Vanessa’s reported use of paper and pencil during game play is significant because during the play of certain games quantities often appear while the player’s hands and eyes are occupied in ways that prevent the use of tools commonly seen in formal mathematical practices (i.e. paper, pencil, and calculators). This leads me to ask how game play might be a context for mental math. It also indicates that Vanessa is actively importing strategies from math class into her game play and vice versa.

In the few instances where our participants reference school-based content in the context of video games they are making active connections between gaming and school

activities. These instances are, however, a small part of the overall data set. More commonly the participants do not draw these same connections indicating that they do not see a significant relationship between school and game play. For this reason I look beyond the instances they cite as related to STEM disciplines to understand how quantities are sought out and acted upon during game play.

Data

I present two cases in an analysis of how quantitative information is represented in video games and how this information gets used during game play. The two cases are informative when compared because they both look at how quantities are used to weigh resources against what the participants are trying to accomplish and how quantities are used to develop in-game strategies. The first case looks at Mikey and Johnny, two brothers who frequently play together and sometimes play with their younger sister. The participant in the second case is Vanessa a young girl who, despite having friends, an older brother, and a parent that plays video games, most often plays by herself. Both the brothers and the girl play in their families' living rooms while their parents engage in other aspects of domestic life (e.g. making dinner, paying bills, etc). They also make use of social and material resources from outside the game in both cases. The cases are based on games that differ in how the player interacts with and controls the characters on the screen along with the organization of tasks within the game. The instances used in the first case are of Mikey and Johnny playing the game *Super Smash Brothers Melee* (SSBM) on the Nintendo Gamecube. The second case is based on Vanessa's play of the

game *Final Fantasy X-2*. Because each game contains its own nuances and complexities, I will present relevant information on the two games throughout the chapter.

I also draw on information gathered during exit interviews. The participants were asked to annotate images from video games as well as one minute of corresponding video using *Video Traces*¹. Three guiding questions were given before the participants began the annotations: (1) identify the game, (2) tell what is going on in the game, and (3) tell how they would determine who is going to be successful. This is a form of an artifact-based or elicited interview common in social sciences. The interview method I used is similar to Barron et al's (2002) artifact-based interview where children's projects were represented in interviews to assess their learning. The purpose of using this technique is to draw out the participant's perspective on specific issues relevant to the analysis. In this case, I was interested in how the participants used quantities represented by the game to make decisions in the game. My observations led me to believe that there were moments when it was likely that they were using the quantitative representations. I then selected video and screen images from those moments.

The cognitive system

Both cases draw on a distributed perspective of human activity advocated by Hutchins (1995a; 1995b). In using this perspective, the boundary for the unit of cognitive analysis is expanded beyond an individual to include artifacts, tools, and people relevant

¹ *Video Traces is a computer-based medium that allows for annotation using talk, gesture, and drawing of video and still images.*

to accomplishing a given task. The expanded unit, referred to as a socio-technical system, is analyzed to understand how information flows and is processed within the system. In doing this, an understanding how individuals interact with representations is gained, as I want to understand how game players interact with quantitative representations during game play. “This system-level cognitive view directs our attention beyond the cognitive properties of individuals to the properties of external representations and to the interactions between internal and external representations” (Hutchins, 1995b, pg. 287). Hutchins used this perspective in an analysis of navigation aboard Navy ships (Hutchins, 1995a) and landing within airplane cockpits (Hutchins, 1995b) to demonstrate that properties often attributed to humans are in fact better described as interactions within a socio-technical system.

My intention is to use the distributed perspective to analyze the flow of quantitative information across people and technology during game play. As I argued above, quantitative representations appear in many video games in ways that are significant to what the player is trying to accomplish. This accounts for an exchange of information from the game to the player. I posit then that the player acts on this information and uses an input device (controller, keyboard, etc) to send a different set of quantities to the game. This analysis then is an attempt to understand how the player uses the representations provided by the game. For my purposes the socio-technical system includes the player, the game console, and any other artifacts that are used to accomplish a given task. Artifacts might include published strategy guides and handwritten notes.

Figure 3.2 displays the flow of information within a representation of this system based on my observations of kids play in several settings.

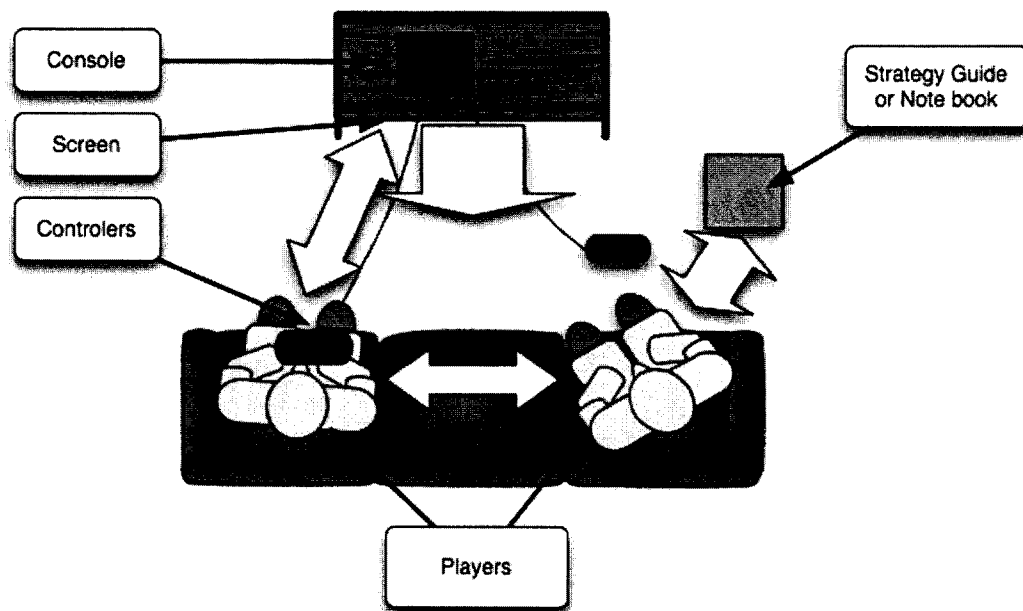


Figure 3.2: A sketch of the distributed game system. The large white arrows represent the flow of information in the game systems described here.

Case I: Knowing when it is time to start over

Throughout my field visits, Johnny and Mikey frequently played the game *Super Smash Brothers Melee* (SSBM). This case presents an analysis of Johnny and Mikey's play of SSBM to show how quantitative information in the game is used to determine the likelihood of success and to develop strategies. SSBM is a game in which two or more characters fight each other (see Figure 3.3) in battles until a predetermined set of conditions are met. The characters' movements on the screen are directly controlled by the player (in the second case I will show an example of how characters are controlled differently in another game). The game has many different modes of play, however, in this case, I describe Johnny and Mikey playing the single player "events" mode. In the

events, mode players can choose from 50 scripted challenges that predetermine constraints on the game activity. For instance, the game will determine how many and which characters are involved and the goal of the event. I have recorded Johnny and Mikey playing the events mode over approximately 95 minutes across three separate occasions.



Figure 3.3: This is a screen shot of a typical battle in SSBM. In the circle we see the two characters that are battling in this scene; Johnny controls one and the computer controls the other. Inside the rectangles are the quantitative representations.

In this case, I bring attention to how Johnny and Mikey use quantitative representations given by the game as they work through the events. I draw on Hutchins' (1995a) description of computational image devices used by navigators. These devices provide an easy way to represent quantitative information in both digital and analog form.

Depending on the task at hand information is more useful in one form over another.

For instance, navigators may convert an analog representation of direction and location (a line on a chart) to a digital form (latitude, longitude, and heading) for computational purposes. Despite differences between navy ships and video games, I contend the participants use representations present in video games to make calculated decisions as navigators do aboard navy ships. The analysis begins with an observed pattern in the boys' game play. Frequently the player (either Johnny or Mikey) will end an event before the game has told him he has failed. I will show that in these cases Johnny and Mikey use information given by the game to determine their chances of success and to develop strategies.

Weighing resources to determine chances of success

Johnny, and to some extent Mikey, make heavy use of a feature that allows the player to restart any match instantly without repercussion to the overall record that is stored on the game's memory card. Figure 3.4 shows how 101 event attempts I recorded ended. If the game flashed "failed" on the screen, then the event ended unsuccessfully. If the player is successful, "success" flashed on the screen. When neither "failed" nor "success" flashes on the screen, then the player has voluntarily ended the event. In the time that I observed them playing this mode the two boys did not wait for the game to tell them the outcome 59 (58%) times. How then did they know that a particular attempt would not be successful? I contend that Johnny and Mikey make use of the quantitative representations to determine the likelihood of their success by weighing what needs to be done against the resources they have left in the game.

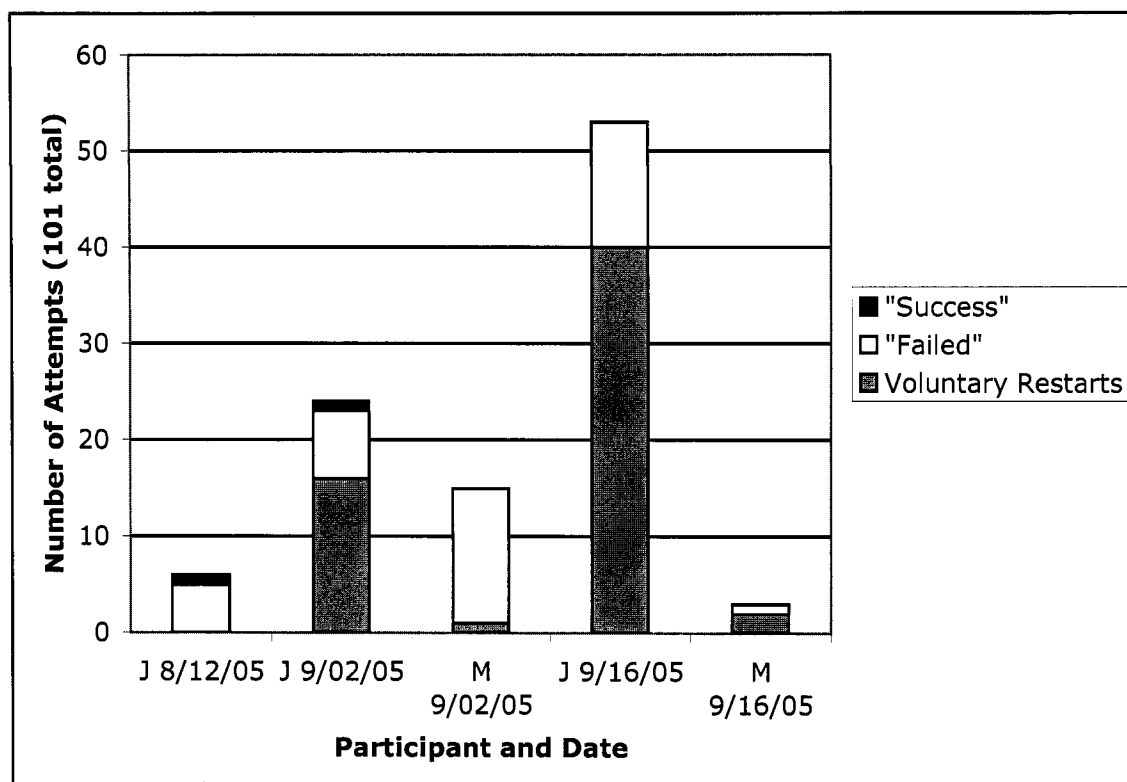


Figure 3.4: A graph that shows the how the 101 attempts at various events broke down by whether the participant was successful ("Success"), the game told him he was not successful "Failed" or he stopped the attempt early to start another one (Voluntary Restarts). The graph shows that voluntary restarts are a common part of their play. M = Mikey and J = Johnny.

The image in Figure 3.3 was taken just as Johnny was resetting and had indicated verbally that he will not be able to complete the level, "I'm not going to be able to do it" (Johnny and Mikey 9-16-05 Tape 2 00:36:51). It is difficult to determine whether or not Johnny is correct in his assessment since he did restart the game. However, when shown the same image and a corresponding video during the exit interview he made a similar prediction. Considering the information Johnny had available to him from the game at that moment his statement is reasonable. I will describe the representations that supply the information Johnny had available, their meaning, and how they are used. The representations are a means by which information flows to the player. In this instance, the

player (Johnny) uses the information to balance what needs to be done with the resources his character has left in determining the likelihood of success. The screen shot in Figure 3.3, taken when Johnny made the decision to restart, has three different quantitative representations in digital, analog, and mixed forms².

First, the number “00:17:93” positioned at the top center of the screen indicates how much time he has left. Time is a limited resource available to his character throughout the entire challenge. Prior to the moment when he restarted, Johnny references the time left in the event at 52 seconds and at 33 seconds, indicating that he is aware of this quantity and monitoring it as he plays.

Second, the top left corner has two icons. These icons represent the characters Johnny still has left to defeat, including the one he is currently battling. They are an indication of what needs to be done in the game. In analog form these representations provide a great deal of quantitative information beyond the number of characters left. This includes each character’s unique qualities, such as strength and speed. In other instances, I saw Johnny and Mikey discuss the characters’ strengths and weaknesses without information presented in digital form. The two images then also represent the difficulty of the battles to come. During the exit interview Johnny called attention to the icons in the top left corner as a means to recognize the specific challenge shown in the image and to talk about what the challenge entailed. The specific moment in Figure 3.3

² I use “digital” in reference to information that is represented using digits; “analog” in reference to information represented using icons; and “mixed” in reference to information represented using both digital and analog forms.

shows that he has two characters left to battle. The one currently on the screen and another character once the current foe is defeated.

A third set of representations appears on the bottom of the screen. These representations indicate the status of each character in the current battle through an icon and a percentage. By indicating how much life and damage each character has the representations show both available resources and what needs to be done in the game. Later in the chapter, I analyze in more detail how this specific representation works. In Figure 3.3, both characters have one life left. Johnny's character has 170% damage, well over the 100% damage mark where one significant attack on her will result in a loss of life. Therefore, as a resource for Johnny, life is limited. The other character has 34% damage. During a field visit and during the exit interview Johnny has stated that the most damage a character can inflict in one move is 20. From this we can assume that Johnny recognizes several moves are needed against a powerful foe to reach the 100% threshold. Additionally, another attack will be needed to defeat this character. This represents a rather significant amount left to do in the game given the limited time displayed on the top of the screen.

On other occasions, I have seen Johnny and Mikey use the quantitative representations on the bottom of the screen to balance the amount of life their character has left with the other characters' current state. For example, while Johnny was playing the events mode Mikey watched and suggested, "you might want to reset, the only person who has lost a single life is Pikachu" (Johnny and Mikey_2005-09-16 Tape 1 00:12:59.03). In that particular instance, Mikey looked at the representations on the

bottom of the screen and calculated the amount of life the opponents have lost to determine how much of the challenge Johnny has completed. His assessment is that Johnny has not as of yet made significant inroads into the challenge based on his reading of the representations on the bottom of the screen and presumably the time that has passed shown on the top of the screen. Mikey then suggests that Johnny restart the event. In other words, Mikey made use of and referenced the information given by the game to make a claim about the state of the game. The representations then serve as computational image devices that allow Mikey to calculate the likelihood of Johnny's success.

Let's return to the moment shown in Figure 3.3 where Johnny declared that he was not going to be successful before he restarted. If we consider the number of moves needed to defeat the character Johnny is battling in Figure 3.3, a dwindling clock that Johnny is monitoring, the additional character he has to defeat, and the limited amount of life his character has left then we can see his statement, that he is "not going to be able to do it" (Johnny and Mikey 9-16-05 Tape 2 00:36:51), as reasonable. In terms of the distributed system, information was presented to Johnny and he made a decision based on that information. Johnny used quantitative information that represented what needed to be done with information on the resources available to his character to influence action in the game.

Calculating damage to develop a strategy

In addition to using representations as a means to balance what is left to accomplish in a game with the available in-game resources, Johnny and Mikey use the

same representations to develop strategies in the battles. They use the quantitative representations to monitor the damage particular moves dole out in the game. By monitoring how much damage the characters are taking on and giving out, they are able to figure out which moves are best to use at different points in the battle.

In Segment 3.3, taken from a field visit, Johnny and Mikey discuss a strategy to beat a particular event in SSBM that challenged Johnny. This same segment was used in the previous chapter titled, *Making and Breaking Routines*, as part of a longer analysis of gaming routines. At the moment captured in Segment 3.3, Johnny is controlling a character named Jigglypuff on the screen and attempting to defeat three other characters that are all working against him. Mikey is sitting next to him watching the action. In this segment, Mikey suggests a strategy to Johnny based on a calculation he made from the representations on the screen. His suggested strategy is that Johnny hold off on using Jigglypuff's "instant KO" until the other characters have some damage. This strategy, which Mikey calls defensive, is based on his assessment of how much damage each character has been accruing.

Segment 3.3

1. M: You got to load them up on some damage before you do that (9 sec.)
2. J: ahhh ((restarts the game))
3. M: You might want to play defensively. (7 sec.) Just keep on defending and let them beat the crud out of each other until they got about 70 damage each and then blow 'em up. Cause as of there it only does 20 damage and it won't kill 'em I just figured that out=
4. J: =twenty damage is the most you can get out of a move though.
5. M: Yeah still just play defensively and load 'em up on it.

(Johnny and Mikey 2005-09-16_Tape1_00:15:55.26)

In turn 1, Mikey suggests to Johnny that he should hold off on using a particular move, "instant KO." Then, in turn 3, he tells Johnny to use the quantitative representation

to know when to apply the move: “until they got about 70 damage each and then blow ‘em up.” He then states that his reason for this using this strategy is that the move only does 20 damage, information he gathered by watching the changing quantitative representations on the screen.

In addition to my field visits, I presented Johnny and Mikey with three one-minute video segments and corresponding images from SSBM during the exit interview. Using *Video Traces* they annotated the images and videos. In several of his annotations Johnny employed the representations along with the characters’ actions to make calculations that were used to explain strategies in the game.

While watching one video from SSBM, Johnny was critical of the strategy that had been played in the game and used the quantities represented by the game to explain his position. During his critique, quoted in Segment 3.4, he sites a specific attack (turn 1, “a PK thunder”) and then says how much damage it will cause (turn 3, “twenty damage”). While explaining the strategy, to use a PK thunder, he references and points at the quantitative representation seen at the bottom of the SSBM screen in Figure 3.3.

Segment 3.4

1. J: And see right here I should have done a PK thunder and hit myself in the back with it and then I'd turn all a lightening at him ((circles the character he controlled and draws a squiggly line to the other character)).
 2. T: hmm
 3. J: And it would have given him twenty damage to here ((circles his opponent's percentage on the bottom of the screen and writes 20 over it)).
 4. T: That would give him a hundred and twenty damage?
 5. J: No, just twenty.
 6. T: Oh, just twenty?
 7. J: But that's really big for one attack. And it would have sent him flying.
- (Johnny and Mikey 2006-01-12_img3-2_00:01:25.26)

Based on the segments presented above and the observed pattern of restarting, I infer that Johnny and Mikey's game play includes making use of the representations given by the game and the actions of characters on the screen. The representations are used to assess the status of the characters and the damage particular moves are making. Their assessment then are used and to develop strategies for beating the game. In the next section, I will look more closely at one of the representations in this game and discuss its relation to school-based mathematics.

Place value

I will end my analysis of Johnny and Mikey's use of quantitative representations in SSBM by looking at a specific representation in this game, the icon and percentage seen at the bottom of the screen (see Figures 3.3, 3.5, and 3.6). Together the icon and the percentage make a rather strange quantitative representation. Not only does the representation involve a mix of analog and digital forms, but it also makes use of a place value system in which one place increases while the other decreases. The icons above the percentage indicate how many lives each character has left--this decreases as the battle progresses. The percentage indicates how much damage the character currently has. This percentage increases as the battle progresses and the character sustains more and more damage. Here Mikey explains what the percentage means: "If it passes a hundred you get easier to throw off the screen, so every time you get hit it goes up" (*Johnny and Mikey 2005-07-14_00:23:48.16*). If a character is thrown off the screen, a life is lost and the number of icons above the percentage decreases by one.

Despite this representation's non-standard form, Johnny and Mikey fully understand how it works. While annotating videos of in-game action during the exit interview the following interaction occurred (see Segment 3.5).

Segment 3.5

1. T: So, how would you tell who's going to be successful?
2. J: Whoever's got the most ((pauses the video))=
3. M: =most lives and least amount of damage.
4. J: most lives and least amount of damage ((circles an icon and a percentage)). Or a computer player that's like the highest level.

(Johnny and Mikey 2006-01-12_img3-2_00:00:40.18)

In Segment 3.5, while describing how they knew who was going to be successful, Johnny circled the icon with the most characters in it. He then circled the icon with the largest percentage (see Figure 3.5). Also, notice that in his explanation he considers which character is the highest level, information not present in the life indicator (Segment 3.5, turn 4). Rather than simplify the situation, Johnny makes use of quantitative information that complicates an assessment of the characters' current status. Near the end of the same annotation, Johnny explains further that while the percentage increases, the icons, which represent the number of lives left, decrease: "And then here he should have died ((draws arrow to opponent)). If he had a hundred sixty one damage or just a hundred ((draws over opponent's percentage))" *(Johnny and Mikey img3-2_00:02:41.13)*.



Figure 3.5: Shows how Johnny used the drawing tool in Video Traces to point at quantitative information to determine who was going to be successful. He has added the circles on the bottom around the icons and percentages, pointing specifically at the quantitative representations.

One of the images and corresponding videos Johnny annotated was identical to the image in Figure 3.3 that was taken just before Johnny restarted an event in SSBM. While explaining the characters' actions in the video segment that corresponded with Figure 3.3, Johnny included a mathematical representation of ' $80-25=55$ ' (see Figure 3.6) in the column format. Subtracting numbers in columns is, of course, common in school-based mathematics and so its emergence in an interview about video games was surprising to me. My inference is that Johnny used the calculation to describe the amount of damage his character, Samus, will take on by the end of the segment. What follows is a description of how the school-based mathematics fit into Johnny's

explanation of the video and how it indicates that he understands and is able to use the strange representation provided by the game at the bottom of the screen.

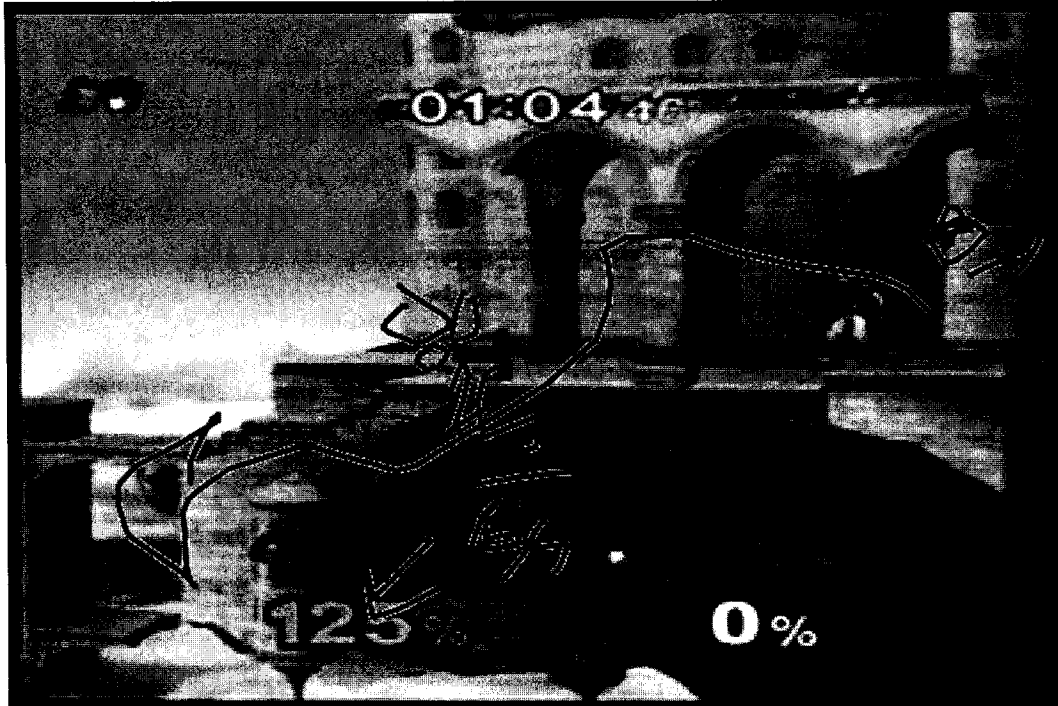


Figure 3.6: Written annotations Johnny made to a video segment leading up to the image in Figure 3.3.

Johnny was first presented with the still image in Figure 3.3 that was taken just before he restarted an event in SSBM. As previously described, he was asked to talk about whatever he would like but to try to answer three questions: (1) What game is it? (2) What is going on in the game? (3) How would you figure out who is going to be successful? Prior to seeing the image he was not given any background information on where it had come from. Johnny made the following statement in his annotation of it.

Segment 3.6

[1] And since there's only two people left out of the eight ((draws two arrows pointing to the small icons on the top left)). [2] You- she's taking a lotta damage ((circles 170% and icons on the bottom of the screen)). [3] And she's about to use her electro whip to grab him and throw him, (T: so who do yo-) [4] but he's probably going to evade it and hurt Samus [5] to give her another ten damage to go to a hundred-eighty.

(Johnny and Mikey 2006-01-12 img1-1_00:00:28.16)

Despite not having seen the video, Johnny's annotation includes a description of actions that potentially lead up to and follow the moment when the image was taken. This description is based, in part, on information presented in the representations at the bottom of the screen. I have broken Segment 3.6 up into five parts (marked in the brackets above) to clarify my interpretation of his description. He uses the quantitative representations (parts 1, 2, and 5) to point at the character's current status in relation to their apparent actions in the game at that moment (parts 3 and 4). In parts 2 and 5, he references the representation at the bottom to describe the characters current status, "she's taking a lotta damage", and a potential future, "give her another ten damage to go to a hundred-eighty." Using Segment 3.7, I will show how Johnny brings in the school-based mathematical representation to talk about how the representation at the bottom of the screen changes while the game is played.

Segment 3.7

Well, in a few seconds Samus is gonna go down and flip back up over him ((draws line between two characters)) then go over here and grab an umbrella, then grab a pokéball and throw it. It's got a Togapea using a sleep attack of metronome, but then he dodges both the pokéball and the pokémon in it so then he beats the heck out of Samus. And adds another. ((begins drawing numbers)) Let's see eighty minus twenty-five (laughs) is sixty. Wait. No, fifty-five. So that adds another fifty-five to my occurred damage points and then she sor- and then it ends.

(Johnny and Mikey 2006-01-12 img1-2_00:00:14.07)

Johnny watched the video once and then accurately described the characters actions in his annotation quoted in Segment 3.7. In comparison to Segment 3.6, Segment 3.7 includes more of the characters' actions. Johnny relates the characters' actions to the quantities on the bottom of the screen, "he beats the heck out of Samus. And adds another.... fifty-five to my occurred damage points". In his description of how the characters' actions influence the quantities in the game, Johnny includes 80-25. Based on both Segments 3.6 and 3.7, I interpret Johnny's calculation as his predicted outcome (180) minus the current status shown on the screen (125). Johnny has simplified the problem by excluding the hundreds place. This is a reasonable assumption given his ability to use the game's place value system and other representations from the game. In using this calculation, Johnny is showing how the representation changes in relation to the characters' actions in the game. Johnny's recollection of the character's actions from the video segment are correct. However, his prediction that, in the game play that took place after the image was taken, Samus would take another 10 points of damage is unverifiable because when originally playing the game Johnny restarted at that point.

Across the observations, Johnny and Mikey use quantitative representations in a variety of ways while playing SSBM. As shown above, they use a combination of several quantitative representations to weigh available resources against what needs to be accomplished in the game. This includes using the timer on the top of the screen. They also use the percentage and icon on the bottom of the screen to determine how easy it will be to knock a character off the screen and reduce the number of lives that character has

left. Finally images of the characters are used to determine the difficulty of a battle. In the end, these uses constitute a quantitative practice that fits seamlessly into their game play.

Case II: The use of quantities when killing a fiend in *Final Fantasy X-2*

The second case extends the analysis of how quantitative representations are used in video games to a different participant and game. This case follows a similar structure as the analysis presented in case I. I will begin with a brief description of the participant, Vanessa, and the game played in this analysis, *Final Fantasy X-2* (FF X-2). From there I will describe how quantitative representations are used in this game to balance what the player is trying to accomplish with the resources available to her; a section parallel to my analysis of Johnny's use of the restart button. Then, as I described some of the strategies Johnny and Mikey use in SSBM, I will look at how Vanessa uses quantities in FF X-2 to develop strategies. Finally, I will look at a mini-game within FF X-2 called Sphere Break where mathematics taught in school is designed into the game.

Vanessa and Final Fantasy X-2

Vanessa (age 13) began playing FF X-2 soon after she joined the study. Over time I have observed her play this game on nine different occasions. She also reported playing this game several times a week when I was not there, indicating that she plays this game with some frequency.

FF X-2 is a role-playing game that involves an unfolding narrative based on the adventures of three characters: Yuna, Rikku, and Paine. Throughout this game the player

controls the three characters in what are referred to in the gaming world as turn-based battles. Battles are a common element of most computer based role-playing games (Wikipedia, 2006, Computer role-playing games) and shape much of the “gameplay³.” The battles in FF X-2 pit the player’s characters against one or more enemies referred to as fiends, anions, or bosses. While fighting in a battle the player selects from a menu different ways to attack the enemy or mount defenses against them (see Figure 3.7). The player can also configure each character by using resources in the game to change which attacks and defensive moves they can do. The different configurations, attacks, and defenses make up a large permutation for the player to select from while playing this game. I argue that the process of configuring the characters and engaging them in battle involves the use of many quantitative representations in Vanessa’s play of the game.

³ “Gameplay includes all player experiences during the interaction with game systems, especially formal games. Proper use is coupled with reference to ‘what the player does’.” (<http://en.wikipedia.org/wiki/Gameplay>)

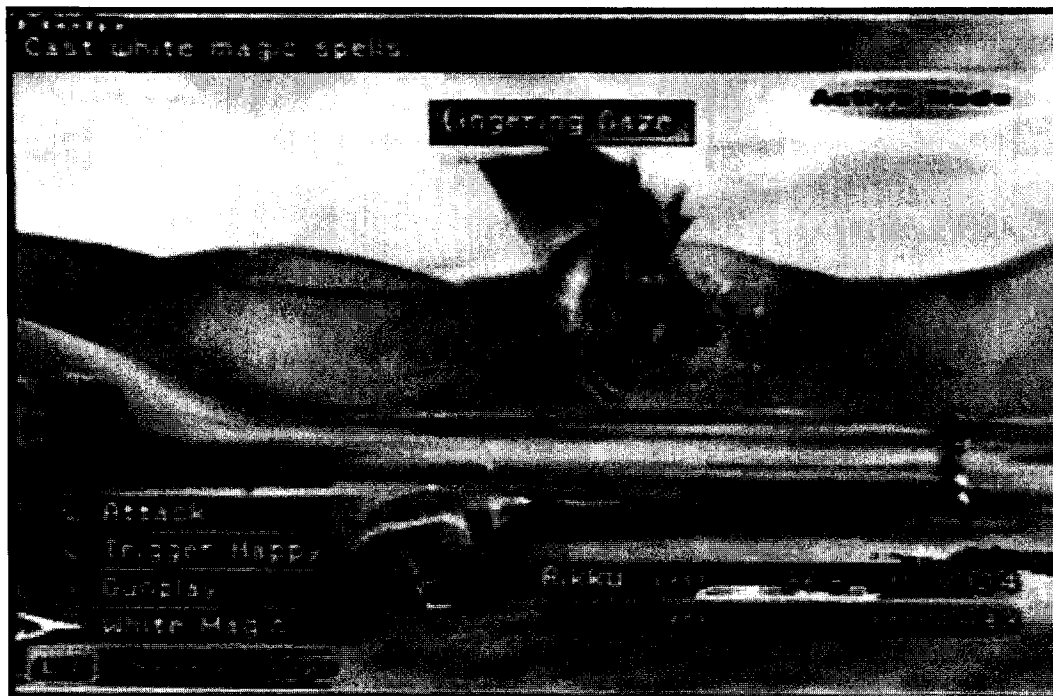


Figure 3.7: This is a common battle scene in *Final Fantasy X-2*. The menu on the bottom left side lists the commands Vanessa can choose for the selected character. Some of the commands are offensive moves (attack, trigger happy, and gun play) others are defensive moves (white magic). In this image, the character selected is Rikku indicated by the coloration of her name on the bottom right. The table on the bottom right side tells the characters' current life status or hit points. Here Rikku has 368 HP and Paine has 0 HP. Prior to this moment, Vanessa had Yuna, the third character she controls, escape so her information is not available. Avatars also represent the characters. In this scene, Vanessa's characters are the humans on the right. The enemies are the flying creature and the hound-like image on the left. Although the character's avatars are animated, Vanessa only control of them is through the menu on the left.

Balancing resources against what needs to be done

The object of each battle is to reduce the enemies' hit points (HP), an indicator of life, down to zero before the enemy reduces each of the main characters' HP to zero. During the battle the main characters' HP is displayed in a table on the right side of the screen (see Figure 3.7). The enemy's HP is not shown in a digital form however at times they will show damage on the graphical representation of the enemy and the number of HP lost after a move appears briefly over the character. There are two basic categories of

moves the player can make in the battle that I will start with. She can attack the enemy, which lowers its HP, or she can play defensively and raise her own HP.

Throughout the content log there are dozens of battles in which Vanessa's characters do nothing but attack. The records also indicate that Vanessa generally won these battles. A list of commands Vanessa used while fighting three simple and routine enemies in one battle is displayed in Table 3.1. During this battle Vanessa mostly used attack commands to lower her enemy's HP; however, she did use a few defensive moves to influence her own HP in the battle.

Table 3.1: This table lists commands Vanessa gave the three characters during a simple battle sequence and the object of that command.

<i>(Vanessa 2005-10-06 00:09:34.13)</i>		
Turn	Character and command	Object of the command
1.	Yuna Darkness Dance, All	Stop enemies from attacking
2.	Rikku Attack, Fem-Goon A	Lower enemies HP
3.	Paine Attack, Fem-Goon A	Lower enemies HP
4.	Paine Attack, Fem-Goon A	Lower enemies HP
5.	Rikku Attack, Dr. Goon	Lower enemies HP
6.	Paine Attack, Dr. Goon	Lower enemies HP
7.	Rikku Attack, Dr. Goon	Lower enemies HP
8.	Yuna Dance Samba Of Silence, All	Stop enemies from attacking
9.	Paine Sentinel For Paine	Character receives less damage
10.	Rikku Attack, Dr. Goon	Lower enemies HP
11.	Rikku Attack, Fem-Goon B	Lower enemies HP
12.	Paine Attack, Fem-Goon	Lower enemies HP
13.	Yuna Samba Of Silence, Fem-Goon B	Stop enemies from attacking
14.	Rikku Attack, Fem-Goon B	Lower enemies HP

Notice most commands are actually called "attack." When used the attack command lowers the enemy's HP. Four commands do not contain the words "attack": darkness dance (turn 1), samba of silence (turns 8 and 13), and sentinel (turn 9). In this instance, darkness dance and samba of silence are not attacks for how Vanessa has

configured the character Yuna. They are commands that disable the enemies in particular ways limiting their ability to attack Vanessa's characters and therefore do not lower the enemy's HP. The sentinel command is also a defensive move; it allows a chosen character to receive less damage for one turn, thereby positively influencing the character's HP. By selecting different moves that either raise her characters' HP or lower the enemies' HP, Vanessa is using quantities in the game to balance her resources with what she is trying to accomplish.

In the beginning portions of the game battles, such as the one displayed in Table 3.1, are somewhat simple. The three characters get attacked, then Vanessa commands her characters to give out a series of attacks on the fiends. Eventually the fiends HP goes to zero and Vanessa's characters win the battle. After a battle is finished Vanessa often raises her characters' HP with potion. This is done by going into a menu screen like the one shown in Figure 3.8, selecting a potion, and then applying it to a character. When she does this, the quantitative representation for HP shows a visible change. She has indicated this is so the HP is high for the next battle. As the game moves to more difficult levels she retains this practice of raising her characters HP by using potion after battles.

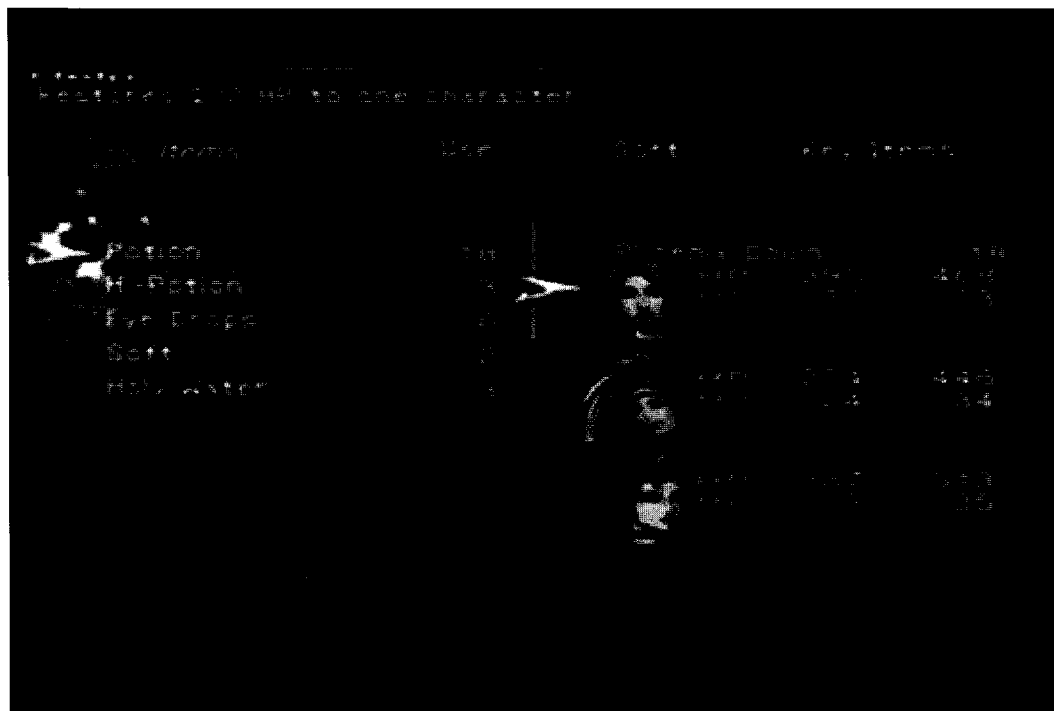


Figure 3.8: An image of how Vanessa raises her characters' HP with potion after battles.

So far I have explained the most basic ways that Vanessa manages two similar quantities in FF X-2: her HP and the enemies' HP. By using attacks, defensive moves, and potions, Vanessa balances what she is trying to achieve (getting the fiend's HP to zero) and the resources she has available for her characters to use. In the next section of this case, I will show how Vanessa uses quantities in the game, such as HP, to develop strategies for defeating her characters' enemies.

Three strategies for killing fiends

Analysis of the data set indicates that Vanessa makes use of variations on three different strategies while battling enemies in FF X-2. As Vanessa explained during the exit interview, her strategy depends on who the enemy is. Simple enemies require only attacks, which lowers the enemies HP. Medium enemies require attacks plus the use of some items and selected abilities. Using items, such as potion, is one way Vanessa can

raise her characters' HP. Difficult enemies require special dresspheres, which are one way she can raise her characters' HP and change what they can do. Next I will show examples of each strategy in action and how quantities represented by the game influence the strategy she uses. The examples will be supplemented with portions of Vanessa's answer to the following question during the exit interview (see Segment 3.8).

Segment 3.8

1. T: What about in a battle? Wha- how would you describe your strategies in a battle?
2. V: Oh. When I'm fighting a fiend?
3. T: hmm. When you're fighting a fiend.

(Vanessa 2006-02-16_exit-interview-tape2_00:03:31.03)

Simple fiends: Attack, attack, attack!

"The simple ones, easy ones I just use attack a bunch of times, you know."

(Vanessa 2006-02-16_exit-interview-tape2_00:04:37.06)

Although not entirely composed of attacks, the battle described in Table 3.1 and in the section above is an example of how Vanessa approaches simple enemies. For the most part, she focused on lowering her enemies HP. During the exit interview Vanessa explained that simple battles can become more difficult requiring her to find other ways to defeat the fiends (see Segment 3.9).

Segment 3.9

If it's hard or it's sometimes a fiend may oversoul, which means its gains stronger powers and stuff you know. HP becomes larger and becomes harder to defeat. And so I take for the ability to do that I would have to figure out, one, its weaknesses. That's why I got the strategy guide to um figure out all its weaknesses. Cause its really hard to tell. As I know I had this um, it looked like a large gel, this one char- this one fiend (T: uhh). And so that was really hard to defeat too because each time I tried to use an element it would absorb it or it wouldn't work, so I had to figure out. And the ga- the strategy guide said to either look at the colors, cause it would change colors and so I would use certain elem- the opposite of that element. It's like if it was red I would have to use ice to cool it down (T: hmm). That means it was- it would absorb fire because you can tell.

(*Vanessa 2006-02-16_exit-interview-tape2_00:04:43.11*)

In Segment 3.9, Vanessa discusses the different ways that she uses resources in the game to lower the enemies HP: “HP becomes larger and becomes harder to defeat. And so I take for the ability to do that I would have to figure out, one, its weaknesses.” In addition to the information present in-game she uses a resource in-room, the strategy guide, to figure out how to lower the enemies HP. She also speaks of a specific example of how she used the guide to understand an enemy’s weakness and then select attacks that will lower its HP.

Medium fiends: Attack plus items and abilities.

“Medium rare kind of fiends um, they aren't that hard. There I have to use attack and then I would have to use potions. I usually use attack potions attack potions most the time. (T: hmm) it's pretty easy.” (*Vanessa 2006-02-16_exit-interview-tape2_00:05:40.14*)

The battle shown in Table 3.2 is an example of how Vanessa reacts to a character’s low HP during a battle. This step-by-step description of a battle sequence shows Vanessa using items, including potion, to raise her character’s HP. She also uses attacks against the enemy to lower its HP.

Table 3.2: A sequence of commands given in a more challenging battle. Figure 3.7 is a screen shot from this battle

(Vanessa 2005-08-25 00:46:10)		
Turn	Character and command	Object of the command
1.	Yuna escape	Leave the battle
2.	Paine Attack, Fly Eye	Lower enemies HP
3.	Paine Attack, Fly Eye	Lower enemies HP
4.	Rikku Attack, Fly Eye	Lower enemies HP
5.	Rikku Phoenix down on Paine	Raise character's HP from 0
6.	Paine Attack, Fly Eye	Lower enemies HP
7.	Rikku Potion on Paine	Raise character's HP
8.	Paine Attack, Killer Hound	Lower enemies HP
9.	Paine Attack, Killer Hound	Lower enemies HP
10.	Rikku Switch dressphere to warrior	Change attack options and strengths
11.	Paine Attack, Killer Hound	Lower enemies HP
12.	Rikku Attack, Killer Hound	Lower enemies HP

The first move Vanessa made was to tell one character to escape, a non-attack. I attribute this to a strategy involved with other elements of the game that are beyond the immediate task of killing the fiend. From there, the battle continued with routine attacks similar to the simple enemy example in Table 3.1, until one of her character's HP went to zero.

At turn four in Table 3.2, Vanessa's character Paine was attacked and lost all of her HP (this is when the image in Figure 3.7 was taken). It is here that there is an interaction between Vanessa and the game that reveals how she attends to quantitative representations in the game and uses them to select items. In response to the downed character, Vanessa had Rikku, her one remaining character, use two items to raise Paine's HP (see Turn 5 and Turn 7). Vanessa selected these resources, phoenix down and potion, specifically to raise Paine's HP above zero.

Using a distributed perspective I will consider the flow of information throughout the system at this point. The image in Figure 3.7 shows that the game has told Vanessa that the character Paine has 0 HP in two ways. First, the table on the bottom right side shows Paine's name in red and lists her HP as 0. Second, the avatar representing Paine is no longer standing up. Vanessa then takes this information and translates it into the command seen in Table 3.2 turn 5. The result of this command is that Paine's HP is raised and she is resurrected. I have brought up this specific instance to highlight the flow of quantitative information throughout the system. The representations are a resource for Vanessa to select the right strategy. Her use of the second item (in Turn 7) is further indication that these representations are monitored and part of her decision to use a potion rather than an attack. Vanessa's stopping of her attacks on the enemy and using an item to raise her character's HP is an indication that Vanessa's gaming practice includes the use of representations that come from the game. In this specific battle, Vanessa has responded to Paine's declining HP with a command that raises HP. In other words, she has read the presented information and adjusted her strategy accordingly.

I would also like to draw attention to one of Vanessa's final moves as a lead-in to the next section. In Turn 8 she changes Rikku's configuration by switching her *dressphere* from Gunner to Warrior. This changes what Rikku can do in the battle. By changing a character's dresspheres she changes what the character can do in the battle and the character's strengths. She does this by pressing a button on the controller, which brings up the circle seen on the left side of Figure 3.9. This circle is called a *garment grid*. Throughout the game Vanessa collects several garment grids, which appear in

geometric shapes. She then selects a dressphere that appears as a node on the circle.

The result in the visible representations is that Rikku's HP is raised slightly. Vanessa is also aware of other effects on the character that are not shown in the representation on the screen at this time. In the next section I describe how Vanessa attends to the dresspheres more carefully during difficult battles and considers how they affect her characters' strength and HP.

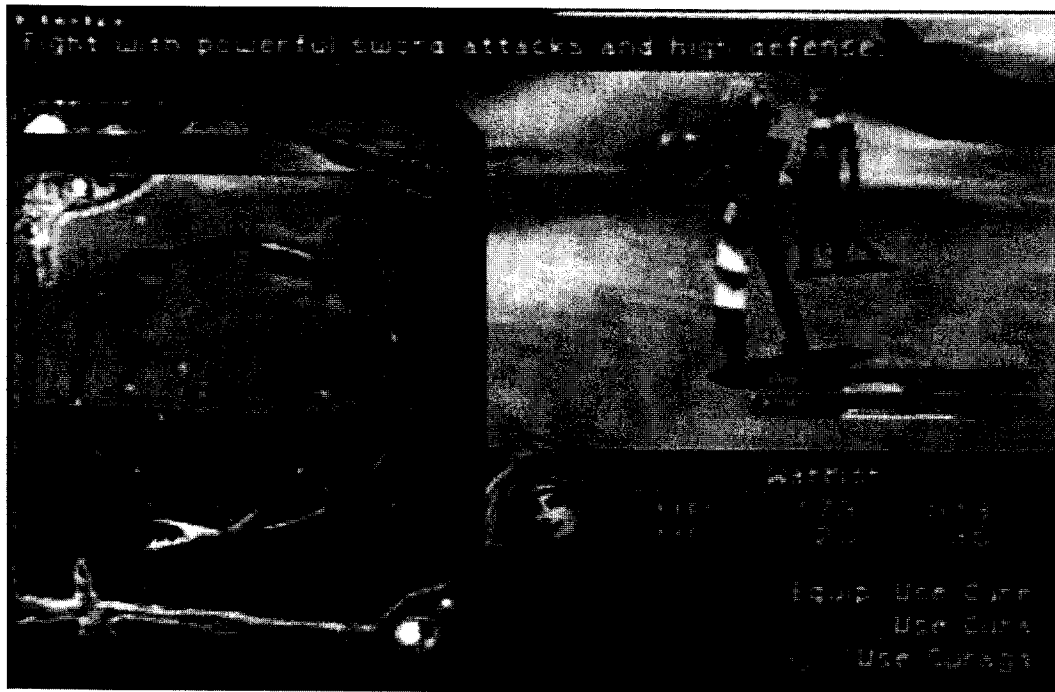


Figure 3.9: This image was taken as Vanessa changed Rikku from a Gunner to a Warrior. The bottom right side shows some of Rikku's stats.

Difficult fiends: Special dressphere

“Mostly on the bosses I used special dresspheres cause it's easier and quicker.”

(Vanessa 2006-02-16_exit-interview-tape2_00:04:32.26)

As mentioned above, Vanessa changes dresspheres while battling difficult fiends, which changes what the character can do in the battle and the character's strengths. For

example, some dresspheres are specifically designed to allow a character to raise the HP of the other two characters. Choosing one of the dresspheres that gives her characters the ability to raise their own HP is one way that quantities are at play in her balancing of the available resources with what she is trying to accomplish.

For the most difficult enemies, Vanessa uses something called a *special dressphere*. Using a special dressphere takes several moves in the battle, however it gives her characters even more strength, HP, and attack options or as Vanessa explains a special dressphere is something “that gains more power” (*Vanessa img14-1*). During one field visit Vanessa explained to me that using a special dressphere is one way that she raises her characters strengths and HP to match the more powerful enemies (see Segment 3.10 turn 7).

Segment 3.10

1. V: So each time like- if it takes a long- if I know its gonna take a long time I usually just put on a special dressphere and just use that instead. Instead of just doing all three of em (T: mhhm) I just use a special dressphere so it'll be quicker.
2. T: So your just one person then?
3. V: Yeah. Use one person only.
4. T: Does that work out for you?
5. V: Yeah. Actually it does. If- uh longer battles any uh bigger fiends with bigger um more power. More powerful attacks. Like aeons, I definitely use special dresspheres on aeons. Cause either I die or it takes too long.
6. T: So why do you think it works better?
7. V: Well I think it's cause, well, since the fiends- it's like the aeons and the fiends both have, you know, have stronger powers and if you use- it's like the same thing as if they had special dresspheres since I have special dresspheres they have special powers. Yuna for example has a power called the great whirl, which does it- it inflicts not elemental damage on each emeny, which causes up to three thousand HP knock out. Which is really good. And I use like different- for Rikku she has this death missle which causes a fiend to explode. And I don't know about Paine but she actually has um ones for- like, like she can lower any anys- um defense or anything down. (T: hmm) That's why I use dress- special dresspheres.

(Vanessa 2005-10-13_00:13:15.09)

It is reasonable to expect Vanessa to choose a configuration for her character that is more powerful when battling difficult enemies; however, her ability to select a special dressphere in an efficient manner is dependent on a bit of foresight. As I mentioned above, using a special dressphere can take several moves in a battle. This is time when her characters are being attacked (losing HP) and she is not attacking the enemy and lowering its HP. The reason using a special dressphere takes several moves is because she must use all of the regular dresspheres the character has available at that time on a garment grid like the one shown in Figure 3.9.

Garment grids come in a variety of shapes and sizes. A comparison of Figure 3.9 with Figure 3.10 shows that the garment grid in Figure 3.9 contains more nodes, which

represent the number of dresspheres in the garment grid. During battle this increases the number of moves it will take Vanessa to select a special dresssphere. When playing parts of the game where difficult battles are expected, Vanessa equips her characters with the garment grid in Figure 3.10. Her explanation in Segment 3.11 indicates that she uses the garment grid in Figure 3.10 because it takes fewer moves to get a special dresssphere.

Segment 3.11

Cause there's there's three- two ways. You can have either one of those big dresspheres- big um big garment grids with more than two nodes *[sic]* ((waves hands in the air)) um. You have to go- you have to use each dresssphere to access the special dresssphere ((points her hand at imaginary nodes in the air several times)). With the other one, which only has two, you only have to go have to go to the other one to use the dresssphere ((waves hand between two imaginary nodes in the air)). So its actually pretty easier to-- Actually you can use all the bigger ones, just in case, cause some of the garment grids have special powers like immune to death or fire powers or something like that.

(Vanessa 2005-10-13_00:16:25.25)

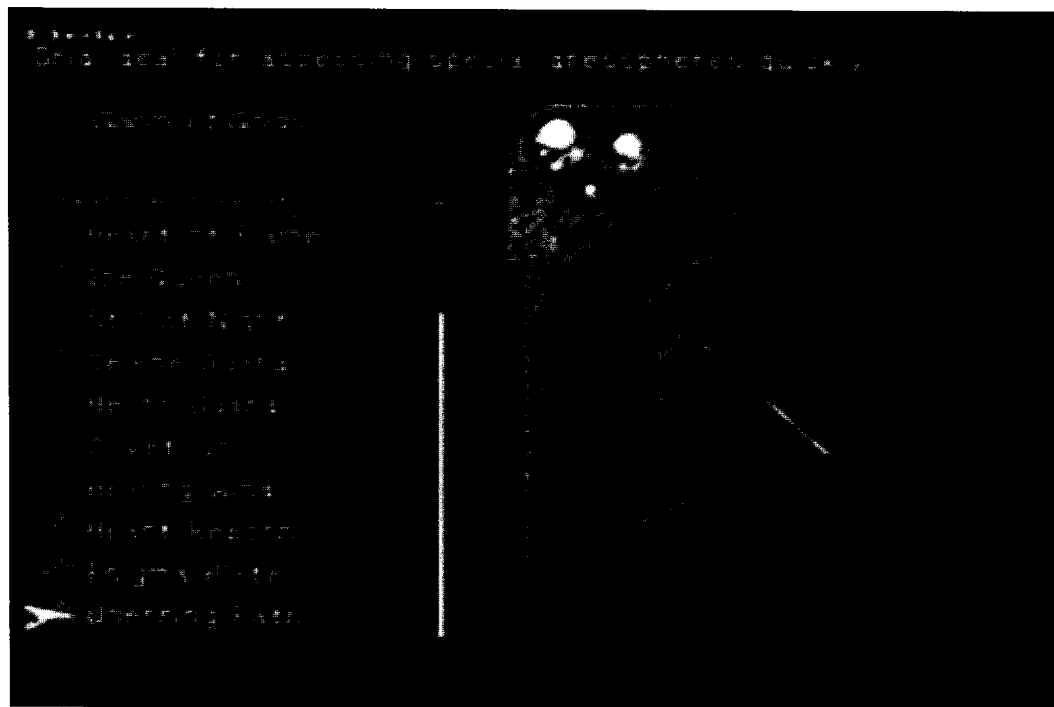


Figure 3.10: A two-node garment grid, ideal for special dresspheres.

Segment 3.11 indicates that Vanessa selects garment grids for purposes other than the ability to quickly make use of a special dressphere; “some of the garment grids have special powers like immune to death.” On one occasion, transcribed in Segment 3.12, she explained how different garment grids give the characters a range of abilities that influence the attacks she can use. By selecting the garment grid in Figure 3.10, Vanessa limits her ability to select a range of dresspheres and to equip her characters with other abilities, but she makes it easier to use a special dressphere. Deciding which garment grid to use involves balancing strengths, HP, and other quantities with what Vanessa is trying to accomplish at that point in the game.

Segment 3.12

1. T: What is all that stuff?
2. V: hmm?
3. T: What's all that stuff?
4. V: Uh. Dresspheres and the garment grids for keeping that. Where I can customize and put different (inaudible). Some of the garment grids have special powers or abilities, like, for Rikku she had Ice Queen which gave the power to use blizzard. Which I'm going to switch over to this one ((switches garment grid to Covetous)), where she can actually drain people's um HP.

(Vanessa 2005-10-06_00:17:40.17)

Vanessa's strategies in FF X-2 depend on interpreting and using quantitative information from in-game and in-room resources. This quantitative information appears in many forms including HP, dresspheres, garment grids, special dresspheres, attacks, and potions. Her strategy guide tells her the difficulty of enemies along with their weaknesses. During battles there is a constant stream of information about her characters' HP. She uses the stream of information to determine which of her strategies to employ. She also configures the characters' garment grids to best-fit anticipated battles. I take the

analysis I have presented in this case to mean that playing *Final Fantasy X-2*, as Vanessa does, involves a range of quantitative practices to balance resources for achieving goals and developing strategies.

Finding Factors in Sphere Break

FF X-2 also contains a mini-game called Sphere Break. In Segment 3.13 Vanessa explains how playing sphere break involves finding the greatest common multiple, content seen in her math class.

Segment 3.13

1. T: Can you tell me what the math was at all?
2. V: It was like using multiples and like figuring out the greatest um greatest common multiple. It was. What was it called. It was Sphere Break.
3. T: uh-huh
4. V: What you are supposed to do is like. um. I think. Like if you had a number you had pick the um um least or um um greatest common multiple that that number showed. Like they had 36 and I had to choose- or it could have been a factor sometimes it goes by multiples or factors. And I could have had like- what's the greatest common factor of 6- 36? I had to choose 6 or any other numbers that break that sphere or that coin.
5. T: umhum
6. V: It was really. It gave me a really headache cause I had use all this multiplication and (inaudible) division. so um. That's kind of difficult.

(Vanessa 2006-02-16_exit-interview-tape2_00:00:38.26)

Figure 3.11 contains a screen shot of the mini-game sphere break. In the center is the number 6 placed on a sphere. The circular objects surrounding the sphere are coins. The object of the game is to select coins that add up to a multiple of the number on the sphere. The first coin selected must be one of the inner four; these are called entry coins. For each outer coin selected one “quota” is earned. The player has a limited number of turns and each turn has a time limit. To win the quota must be fulfilled.

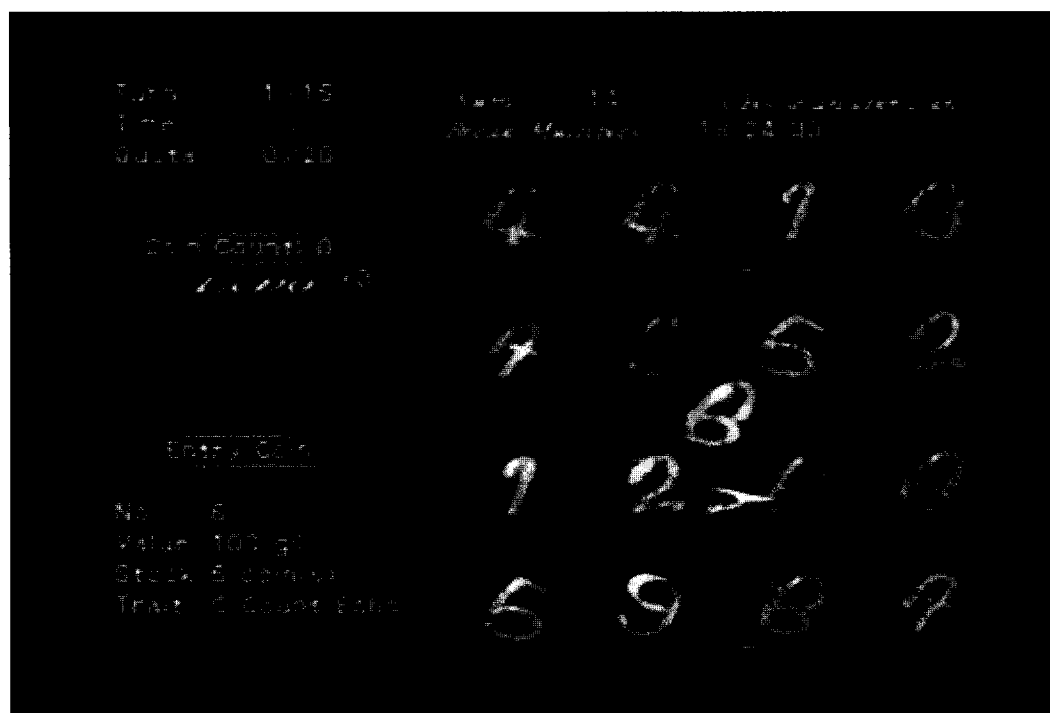


Figure 3.11: A screen shot of the mini-game sphere break.

As mentioned in the introduction to this chapter, Vanessa recognized the relationship between this game and her math class. While playing the game I have seen Vanessa verbally count numbers and struggle to successfully complete many of the matches.

Discussion

In this chapter I have presented two cases of how quantitative representations are used in video games. The cases were presented in a parallel format. Each began with a section that described how quantitative representations were used to balance available in-game resources with what the player was trying to accomplish. Then both cases described how quantitative representations were used to develop strategies in the games. Finally, the cases touched briefly on ways that school-based mathematics finds its way into the video game context. I will use the discussion section to look across the two cases.

Balancing resources

In both cases, the participants used quantitative representations to balance the resources available to them with what they were trying to accomplish. Johnny and Mikey used up to three different quantitative representations on the screen to determine whether or not the current event they were working on was going to be successful. Vanessa's monitoring of her character's HP was also an in the moment assessment of the game's current status. In both cases the participants used this information to make judgment calls regarding which resources are best to achieve a goal. Johnny and Mikey's decision involved a choice between using the restart feature or selecting particular moves to continue working the opponent's life status down. For Vanessa the choice involved selecting attacks to lower the enemies HP or using items to raise her HP. This management of resources is not something that video games explicitly teach yet the participants have become adept at doing it.

My analysis in the chapter titled *Making and Breaking Routines* showed that Vanessa's strategic use of in-game resources in FF X-2 changed over time with the emergence of an in-room resource. Johnny and Mikey had a stable practice in place when my field visits began so I cannot be completely certain as to how they have come to know the representations in SSBM. SSBM is however a sequel and they did report having played its predecessor often. As I described in the chapter titled *Kid's Relationships with Games*, Mikey and Johnny have a gaming career, claiming having grown up playing games. During one field visit they commented that a game without a life indicator would be strange and indeed many games do represent life in some form. My inference is that

Johnny and Mikey have learned to monitor a characters life status as a resource in the game. Vanessa also has a history as a gamer, having played since she was three years old. It is not unreasonable then to speculate that life (or HP) as a quantity that exists across many games is a resource gamers learn to manage and use in relation to what they are trying to accomplish in the game.

Time limits and counters are another common quantity and representation designed into many video games. The games in the cases presented above represent time limits as well. Some of the events Johnny attempts contain a counter, limiting the amount of time he has to achieve the goal. As I showed above, this is something he monitors while he plays. In Vanessa's case, commands in the battle sequences in FF X-2 are possible only after a certain amount of time has passed since the previous command was given. While these representations and their corresponding quantities influence play on a short timescale, they are not the only way this quantity comes into play. Frequently Vanessa will disengage from battles by using the escape option while commenting that she does not have time for the battle. In these instances, the game is not imposing any time limit on her play. Other aspects of life (e.g. homework or an impending dinner time) are limiting the amount of time Vanessa has to play the game and forcing her to consider how to best use this resource. Johnny and Mikey have had similar constraints placed on their game play.

Developing strategies

In both cases the participants used quantities in the development of in-game strategies. Johnny and Mikey used the changing life indicator to determine which moves

in the game were best to use at particular times. Vanessa used her characters' and the enemies' HP and strength to determine which resources her characters should use in battle. These strategies at times live across games.

Vanessa's potion strategy, where she raises her HP after each battle with potion, crosses not only enemies of all levels in FF X-2 but extends into another game. In the game *Kingdom Hearts* Vanessa does the same thing. In Segment 3.14 she explains that her use of the potion depends on how much her characters' "HP is decreased."

Segment 3.14

1. T: Do you usually load up the potion after every battle?
2. V: It depends how many, um, how much- how much their HP is decreased or how much damage they received. Sometimes I only (inaudible).
3. T: Sometimes what?
4. V: I hardly do it at all.

(Vanessa 2005-10-06_00:18:23.21)

When Mikey was presented with images of Vanessa raising her characters' HP with potion after a battle in both FF X-2 and *Kingdom Hearts* in his exit interview, he cited that particular practice as a reason he did not think Vanessa would be successful at the game. Rather he suggested other ways that should be used to raise HP in the game such as configuring characters to raise HP using moves. I bring this up to question the role games have in shaping the quantitative practice. It appears that the player is an active agent in how quantities in the game are used to develop justifications for various strategies and practices in the game.

The difference in the participants' use of quantities and strategies in-game speaks to the complexity of games such as *Final Fantasy X-2*. A well versed gamer, familiar with FF X-2 or similar games, might balk at how my analysis of Vanessa's play focused

only on the battle sequences. Although battles are a significant portion of the game (Vanessa would engage in 10 – 20 per hour of play), I have left out other quantities that are significant in the longer narrative that encompasses FF X-2. Increasing one of these quantities in particular, experience points, is a primary reason for engaging characters in lots of battles. By winning a battle, the characters receive experience points which then strengthens the characters and progresses the narrative forward. So not only within two to ten minute battle sequences are quantities managed and implicated in the development of strategies, but they are across tens of hours as well. I bounded my analysis to the battle sequences in order to describe the use of quantities in achieving a specific goal.

“Math” and video games

In both cases school-based mathematics found its way into the game context. In the case of SSBM Johnny used mathematics to explain elements of how the game works during an elicited interview. FF X-2 comes with a mini-game that makes explicit use of a mathematical concept frequently taught in school, finding multiples. I raise these instances to point to the relative lack of connection between school practices and the game context despite the use of quantities in video games.

The current National Council of Teachers of Mathematics (NCTM) Standards (2006) contain two sections relevant to my analysis: “connection” and “representation.” The section on connections states that:

Students should connect mathematical concepts to their daily lives, as well as to situations from science, the social sciences, medicine, and commerce... Students should recognize the value of mathematics in examining personal and societal issues (National Council of Teachers of Mathematics, 2006).

As I have shown video games, a pervasive aspect of young people's daily lives, involve the use of quantities to balance resources and develop strategies. It is certainly reasonable then to explore how a better connection might be forged between video games and math class.

One possible way to form a better connection between school math and everyday life for young people is through the use of representations. The NCTM standards indicated that representations are important in understanding mathematical concepts.

Representations are necessary to students' understanding of mathematical concepts and relationships. Representations allow students to communicate mathematical approaches, arguments, and understanding to themselves and to others. They allow students to recognize connections among related concepts and apply mathematics to realistic problems (National Council of Teachers of Mathematics, 2006).

The use of similar quantities across video games such as life, time, and currency leads me to wonder whether we should worry so much about what the actual representation are in comparison to what quantities they represent. It seems as though Johnny and Mikey's understanding of the strange life representation in SSBM, that mixed percentages with icons, has little to do with its actual form and more to do with what it actually represents in the context of the game. In other words, as an abstraction away from the game, the representation may be of little use and difficult to understand. In fact, when shown to other participants, not familiar with the game, how the representation worked was often misunderstood. This reminds me of Lave's (1998) analysis of grocery shoppers whose accuracy diminished when faced with school-based representations in comparison to those seen in everyday contexts.

Chapter IV: Games as Adaptable Resources: Educational Design
Recommendations based on an Ethnographic Analysis of Young People's Video Gaming
Practices

My final chapter describes five design recommendations based on my ethnographic findings presented in the previous three chapters (Stevens, 2001). The recommendations build off of a characterization of games as *adaptable resources*. By using the term adaptable resources I am invoking the properties of video games that aid and abet the emergent play observed in this study. The participants' activities in the game environment indicate that they pick and choose pieces of the games to assemble their own experience. The player as an active agent in the game context determines what is to be learned and how to go about it. The game is a resource that can be taken apart by the player to achieve her emergent goals. In this chapter I will describe some of those pieces and give suggestions for how those can be used to build learning spaces for formal and informal educational contexts.

Building a "learning space"

My five recommendations (use of quantities, multiple modes of activity, a multidimensional narrative, bending the game, and heterogeneous set of materials) are intended for use beyond educational games. In this chapter I suggest how they can be used in the design of a medium for learning (Stevens, in press). A medium is a means to do something such as create a lasting inscription or communicate an idea. By extending my recommendations beyond educational games, I have left open the possibility that designs built from them will latch onto existing inertia (Becker, 1995) within the broader educational world. There is also the potential that they will be less subject to conflicts

with the grammar of schooling as many efforts to bring video games into educational settings have encountered.

Scholars such as Howard Becker (1986) have long argued that schools underlining infrastructure does not sufficiently support learning. Stevens (in press) has argued that for lasting change the learning sciences should build “a socio-technical infrastructure for learning” and proposed *Video Traces* as a medium for that infrastructure to help people capture and circulate ideas. My recommendations have some similarities with Stevens approach in that I see them as leading to the development of a medium that allows users to build “profiles”. By profiles I am referring to the portion of a game that is saved on an electronic file that affords sustained play overtime. In many games players build characters, cities, or teams that are returned to each time the game is picked up and played. The specific application that I draw out in this chapter allows users to build a successful STEM (science, technology, engineering, mathematics) student.

Although similar to some constructivist (or constructionist to use the MIT term) educational applications (Kafai, 2006) in my use of a building metaphor I would like to briefly draw out some distinct differences. Unlike constructivist tools such as the LOGO series (Papert, 1980) I do not contend that there are general cognitive benefits to creating a profile in a game system (although there may be). Rather I see any medium built off my recommendations as a means to developing practices through the assembly and mobilization of resources. By assembly and mobilization of resources I am referring to the ways in which game players use portions of the game to accomplish emergent goals (Saxe, 1992, 2002) throughout the process of playing a game.

Use of quantities

My first recommendation is to make strategic *use of quantities*. Appropriately implemented quantities can create situations that force users to make decisions and work through problems. The participants in this study often used quantities to define emergent problems.

Time, currency, and life are examples of three quantities commonly used in game play. Johnny's persistent restarting of the battles in *Super Smash Brother's Melee* prior to the game telling him he failed is one example of how embedded quantities are enrolled into self-defined emergent problems. In Johnny's case two quantities were at play: time and life. In other instances forms of currency are an essential aspect of game play.

Compared with the use of quantities in many formal educational environments, quantities in video games change rapidly. This dynamic aspect of how quantities are enrolled into game play is worth noting when considering how to import this aspect of video games into educational contexts. Quantities in video games have a dynamic nature that allows them to be used as a resource for both emergent and longer more sustained problems in the game context. For instance Vanessa used quantities to develop battle strategies in *Final Fantasy X-2* over several weeks. She developed her strategies by using resources in the game to raise her character's strength and life to match the strength of her enemies. In comparison, Johnny used quantities to determine if he was going to be successful in *Super Smash Brothers Melee* and should continue playing or restart the battle. He made his decision by weighing what he had to accomplish with his remaining resources.

Some problems in games make explicit use of quantities. *Final Fantasy X-2*, which Vanessa played, has a mini-game called Sphere Break where players must find multiples of given numbers to score points. In this case the game makes explicit use of quantities to set the parameters for the problem the player must face. Making calculations with the quantities is necessary to successfully play the mini-game.

Other problems players face make implicit use of quantities. This often occurs when problems are embedded into elements of the story line. For instance, Katarina encountered a chronic snag when the game *Pharaoh* told her she needed more workers at the same time food levels were low. She saw these as competing requests. Unlike Vanessa's play of Sphere Break, the quantities in these instances were not directly manipulated. Rather Vanessa added houses and farms that then influenced the population and food levels.

Based on my observations I recommend incorporating quantities in educational environments to teach quantity as a property of a situation. In everyday situations we assign quantities to qualitative phenomena such as temperature, direction (Hutchins, 1995a), and speed (Hutchins, 1995a, 1995b). As Hutchins (1995a) showed quantities are assigned to phenomena such as direction to help accomplish tasks like navigating large ships. It is worth noting the efforts of the *SimCalc* project, which was similar in that there was a constant assignment of quantity to qualitative phenomena (Roschelle, Kaput, & Stroup, 2000). Also, the quantities in both environments, *SimCalc* and video games, are constantly changing. The dynamic variation of quantities in video games, applied to an educational environment could help users build up a sense of quantity as a property of situations.

Multiple modes of activity

My next recommendation is to make use of *multiple modes of activity* within learning environments to help learners see tedious processes, like solving similar math problems, as contributing to longer projects. By multi modes of activity I am referring to the divergent ways in which players interact with video games. How these modes of activity are enacted can be seen in a comparison of *sustained* and *immediate* play of a game. Sustained play is game activity that occurs over multiple instances and is saved on the systems memory card. Immediate play occurs in a single instance and is not saved on the memory card. On the surface these two forms of activity may seem the same; often the interfaces and controls are the same. The difference lies in that sustained play involves using the computer or consoles memory system to save a profile that can be returned to multiple times. Immediate play occurs when the player engages with the game for a period of time and progress is not saved in the game. In my observations I saw both sustained and immediate play, each of which has its own affordances.

One affordance to a sustained play is that it allows for individuals to maintain profiles within the game space. Maintaining a profile helps the player see repetitive activity in the game as part of a larger project and not necessarily a waste of time. As mentioned above the ability to create a profile is one reason I see the game context as a medium. Throughout the study participants saved their progress in the game using this feature. Some examples of how this feature was used to maintain a project over time can be seen in Johnny and Mikey's play of *Animal Crossing* and Johnny's working through the events mode of *Super Smash Brothers Melee*. During field visits the player would select a segment of the game to work on for a period of time. Over time, small increments

of repetitive action in the game add up and the problems and setting within the game shift to new and more difficult challenges. Allowing for a mode of activity in which users are able to save progress over time is part of how I see my recommendations contributing to the development of a medium because this allowance gives the user something to build on overtime. It is the file, character, or profile that is saved and returned to time and again which makes video games a medium for building a larger project rather than simply interactive media.

In comparison to a sustained mode, an immediate mode of activity occurs when progress is not saved over a period of time within the game. *Super Smash Brothers Melee* is an example of a game that allows for both a sustained and immediate mode. Recall from the chapter *Making and Breaking Routines* that Johnny plays this game on his own using the events mode, where he works through scripted challenges. His play of the events mode is an example of sustained play in that his progress was saved on the memory card and he returned to it over time. Johnny also plays with Mikey in the vs mode, where they battle against each other. Johnny and Mikey's play of the vs. mode of the game when I started my observations is an example of immediate play. When I first observed Johnny and Mikey play *Super Smash Brothers* in the vs. mode no progress was saved over time. Eventually this changed and they began to accrue various quantities over time, however the activity was still directed towards the immediate battle rather than working through a larger set of challenges. Allowing for different modes of activity contributes to a medium that can allow for the player to develop skills with out any kind of record of their failures while also affording them the opportunity to build a project over time.

For instance consider Mikey's comments that "leveling up" can be a long and tedious process, but getting to fight the final boss can make the process worthwhile. School activities are often criticized along similar dimensions. "Skill and drill" mathematics programs are often cited as not providing a deep learning experience for students, who only take away sets of skills that cannot be applied to future problems (Bransford & Schwartz, 1999). Students see repeated exposure to the same problem as "busy" work. From the modes of activity perspective I am proposing the issue may lie in the relationship between sustained and immediate play. A tedious process such as leveling up a character or completing the same math problem over and over is tolerable if it is seen as contributing to a longer project.

A multidimensional narrative

My next recommendation is to use *multidimensional narratives* in educational environments, as video games have, to allow for different pathways through sustained projects. Vanessa's play of Final Fantasy X-2 is an example of how this resource is used in assembling activity. The game has provided pieces of the narrative that are assembled and added over time. This feature allows each player to take a unique journey through the game space while they still encounter common parts of the game. This aspect of the game is used to set personal goals and agendas. From an educational standpoint this is a means to allow users control over their own goals yet set boundaries on where they can go within the medium.

Take for instance Mikey's play of the game *Animal Crossing*. In that game Mikey was juggling several tasks when he entered a store in the game. He was preparing to visit another town, in the process of sending a letter, and collecting items for his house. Each

of these tasks represents different dimensions to the overarching narrative in the game. My argument is that managing these tasks is quite different from how tasks are assigned and segmented in idealized notions of school where children assigned one task after another is completed.

My recommendation here has similarities to project-based instruction where “students work on projects guided by the teacher, usually in groups, that are extended over weeks or months and are organized around fields of inquiry” (Stevens, 2000b, p. 105). However there are distinctive differences between my recommendation and project-based instruction. First, what I am suggesting is not necessarily collaborative work. Second, in video games many of the narrative pieces are preformed whereas in project-based instruction activities are generally less defined. As I see it the advantage to narrative pieces that are preformed is that they provide a greater degree of constraint on the activities the learner is involved in.

“Bending the game” is part of the “lesson”

In the first chapter on kid’s relationships with games, I described how Katarina used her games for purposes that the designers may not have intended, namely as a space for exploration and design. In many educational settings this kind of activity is seen as working against instructional goals. My recommendation is that educational designers rethink how the kind of interactions that Katarina displayed could be used to achieve an educational goal. There were many instances where Katarina bumped up against the inter-workings of the game’s system while attempting to achieve her emergent goals. Most notably this occurred when she sought to trap people in *Zoo Tycoon*. While doing

this she explored the game as a design space and at times developed innovative ways to achieve her own goals.

It is worth considering how her self-directed activity could be used to achieve an instructional goal. From a design standpoint the challenge is to build a system where activity that is not directed by the instructor results in an outcome that satisfies the goal of students' self-directed activity and the instructional purpose. Let us take Katarina's play of *Zoo Tycoon* as an example. Her goal at times was to trap people inside of exhibits. This was often not possible because the system is designed to automatically place a door on any exhibit. Katarina then had to find ways to block the door. If the system had been designed so that the placement of a door was optional, then we might assume she would have not encountered any issues with trapping people. The question designers should ask are: (1) What are the boundaries of the system? (2) What will the user encounter when trying to work around them?

Heterogeneous set of materials

My next recommendation is to make use of a heterogeneous set of materials. By this I am referring to the collection of strategy guides, CDs, web-sites, and communities that make up the game context. These are the materials used in the learning processes described throughout this dissertation. Their use is not prescribed by the game, but formed as necessary by the players. Their learning then may come from selecting resources to achieve emergent goals, meaning that having knowledge in the head is less important than knowing how to use resources appropriately (Stevens, 1999).

Take for example the materials involved in Vanessa's play. She looks to web-sites, friends, and her family for games to play. She also travels to retail outlets and rental

stores to look for new games to play. At the same time she often purchases print materials to guide her through the game. When she brings her new games home they are projected on computer or television screens. Her progress in the game is saved on memory cards or computer hard drives. Within the game there are a variety of ways that action and progress are represented. As I described earlier this occurs through quantitative representations, sound, and other visual images that act as resources for the player.

School contexts have a specific and more restrained set of materials that exist in different forms from the gaming contexts I observed. In other words, in the gaming context use of any one resource is not prescribed as part of an instructional sequence. Just as Lucy Suchman (1987) showed how help guides built into copy machines act as resources rather than scripted plans, I am arguing that materials in the game context act as resources rather than scripted forms of play. One of the mechanisms that allows for this to happen is their use of heterogeneous sets of representations. Such a learning medium would not have a scripted instructional sequence but rather a heterogeneous set of materials that are used to build one's own learning process.

A non-school "game" that simulates school practices

In the final portion of this chapter I will lay out plans for a specific design based on the recommendations I described above. The leading metaphor I use for this particular design is "school". The reason I have chosen school as a metaphor is specifically related to the context in which I see this particular design being used, the home. My intention is that this device will help families better navigate the complexities of school (Stevens,

O'Connor, & Garrison, 2005). One specific activity within this medium that I describe here will be to build a student that can successfully enter a STEM career.

The medium as a whole will build off the basic units of school as described in a variety of naturalistic studies of school practices. These units include but are not limited to grades, classes, after school activities, homework, students, teachers, and assignments. The Artificial Intelligence (AI) that guides the interaction between these units will be based on naturalistic studies of school as well. The AI is intended to be a resource (Suchman, 1987) for the user to engage with the complexities of school.

Naturalistic studies of education have highlighted many aspects of school that students must navigate. For instance, consider Shirley Brice Heath's work on after school activities and the impact they have on a student's current performance in school as well as her argument that these activities are often valued by college admissions offices and employers (Heath, 2001). Built within this medium a user would be able to choose a variety of after school activities. These decisions would impact further choices along with the character's current status amongst teachers and students. The user would have to manage after school activities within a variety of other constraints such as homework and family obligations.

The basic units of the medium I described above (grades, classes, activities, etc) will be the building blocks for a variety of tasks the user can complete. Each task may take several hours, weeks, or even months as is common in game environments. Figure 4.1 is a representation of how the tasks relate to the basic structure of the medium. The user then can maintain a character (a student, teacher, or parent) within the basic system. The character has the ability to move around in the space without completing any specific tasks. The

user can also use the character to engage in a variety of tasks. Figure 4.1 indicates that these tasks may be related to each other. For instance, in this chapter I draw out one potential task, having the character prepare to enter a STEM career, which could relate to another task-- preparing for college.

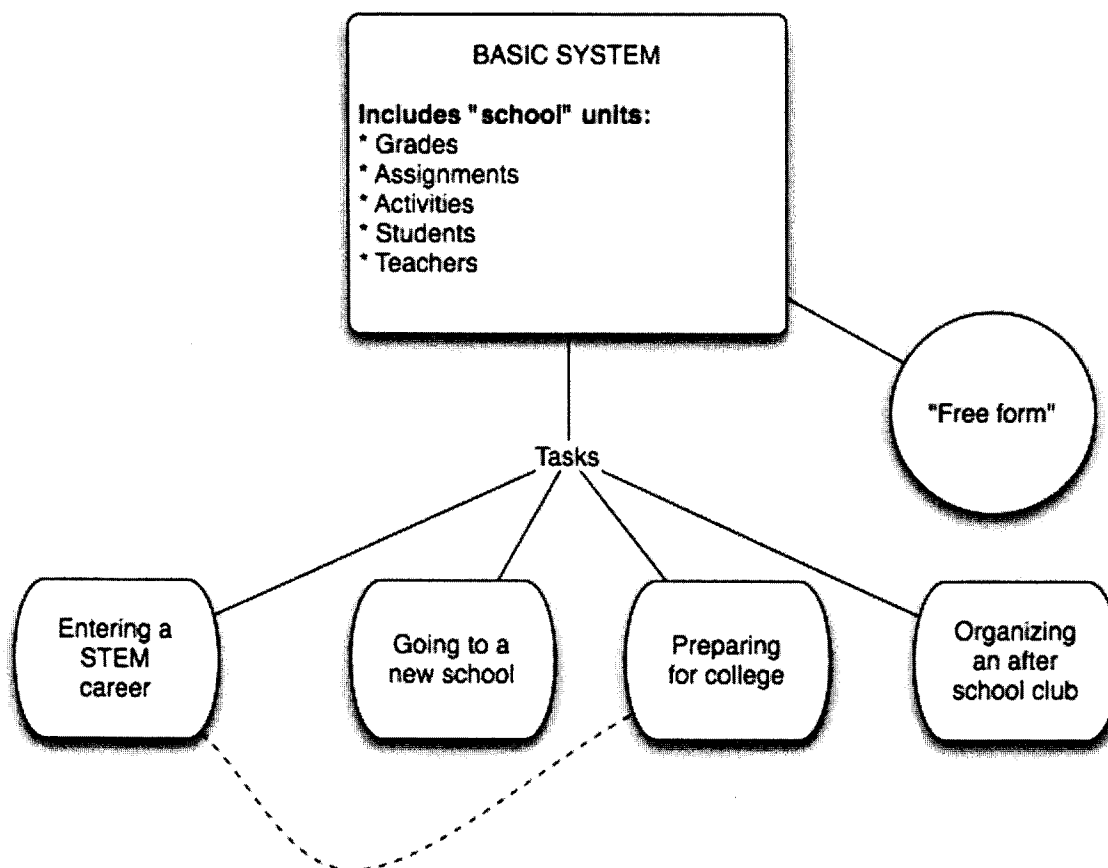


Figure 4.1: A representation of how the medium is structured. At the top level is a basic system which includes many elements that can be used to build tasks. Within the basic system the user can also engage in "free form" activities.

The choice of this particular task, to build a successful STEM student, is motivated by the increased attention that is being paid to the schism between everyday life and school activities. While researchers have begun making a concerted effort to understanding this gap (Bransford, Vye, Stevens, et al., to appear) high school dropouts have used it as a reason for abandoning school (Brigdeland, Dilulio, & Morison, 2006).

My intention is to use the narrative structures common in video games to allow users the ability to engage in the long process of entering and sustaining a STEM career. My working hypothesis is that the medium will represent critical aspects of what is a confusing and complicated process in a single interactive space and allow students to pursue multiple narrative lines through their virtual career. The medium can be used to understand how school activities, non-school activities, and a variety of other resources contribute to a broader the broader goal of entering a STEM career. This particular task is focused on the student's role in navigating the educational system. Ethnographic studies of STEM students have shown navigation as an important dimension to successfully obtaining a degree (Stevens, O'Connor, & Garrison, 2005) and potentially entering a STEM career.

The STEM career task will begin when a student has entered middle school and will involve deciding a variety of aspects related to the character's past. In the same way the *Sims* allows players to determine personality traits, users will have to determine qualities such as past grades, interests, and reputation amongst teachers. Overtime the user will have to engage the character in a variety of activities that may or may not contribute to entering a STEM discipline. The task will end once the character is credentialed to enter a STEM career by obtaining a college degree.

Five recommendations in this design

I will elaborate on both the basic structure of the medium and the task of entering a STEM career by describing how my five recommendations are represented in the system. Figure 4.2 is overview of how each recommendation is represented in the system.

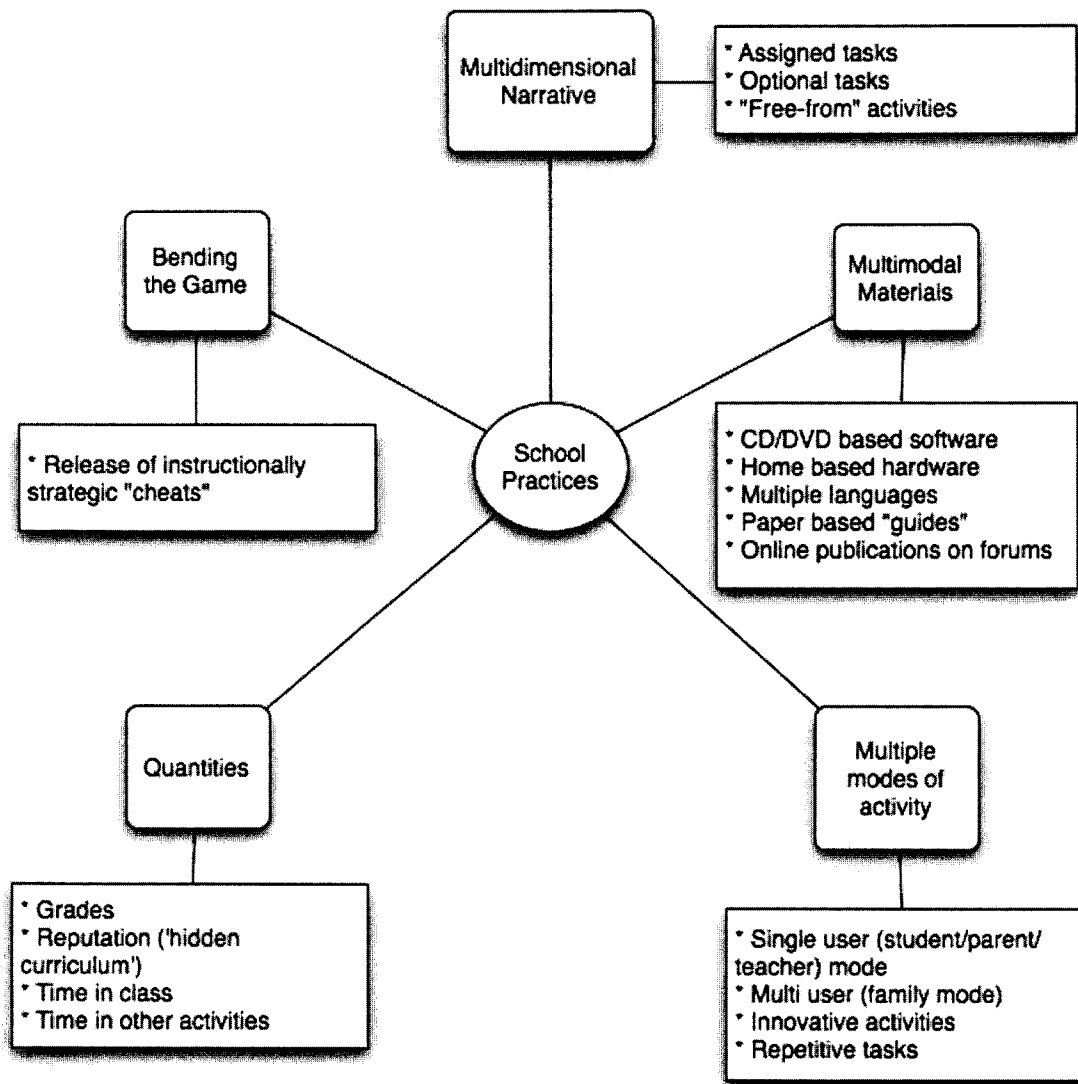


Figure 4.2: An overview of how my five recommendations are implemented into this particular system.

Multiple modes of activity

I envision this design making use of both a single player, student, teacher, or parent, mode and a multi player, "family" mode. In either mode each user will control one character. Depending on what mode the user is working in tasks may differ.

The single player mode will allow a user to maintain a student, teacher, or parent over an indefinite period of time. In this mode the user will engage the character in either

predefined tasks (such as entering a STEM career) or building various aspects of the character in a free from mode.

In the free-from mode, the character will be able to move around in a three-dimensional space to places such as school, community centers, and home. The intention is that the medium will be used as a context to build a successful student using resources seen in the real world. When in the free-form mode the user is not engaged in a specific task but has the ability to move the character around in the game space and interact with its various parts.

The multiplayer mode will look similar to the single player mode but allow for other users to participate. A new set of tasks will be available in the multiplayer mode. These tasks will be typical of activities that involve more people than the student in the real world. For instance, users may have to gather information and make decisions on colleges or work on group projects in school.

The use of characters is based, in part, on the “Identity Principle” Gee claims as being built into video games.

Learning involves taking on and playing with identities in such a way that the learner has real choices (in developing the virtual identity) and ample opportunity to meditate on the relationship between new identities and old ones. There is a tripartite play of identities as learners relate, and reflect on, their multiple real-world identities, a virtual identity, and a projective identity. (Gee, 2003, pg. 67)

As I described in the chapter titled “Kid’s Relationships with Games”, Gee (2003) argues that some video games allow for three kinds of identities: virtual, real and projective. These three identities are used to describe the relationship between two actors in the game context, the player and the character, and to highlight the potential benefit

this interaction has for the player. The three identities Gee describes each locate agency in a different place. In the virtual identity the agency is located in the character that lives in the game. In the real identity agency is located in the player living in the real world. In the projective identity agency is located in the transmission between the player and the character.

Gee presents his three identities as a way to focus attention on the projective identity, which he claims invoked in a classroom would allow students to explore various identities “to be a certain sort of person and to have had a certain sort of history” (pg. 65). From a progressive educator’s perspective this kind of exploration is appealing yet as I see it does little to counter the question many teachers face: ‘when will I use this in the real world?’ It still treats disciplinary practices, such as mathematics and science, as separate from the everyday practices children are involved in. My intention here is to treat common aspects of kids’ school life as related to eventual careers in math, science, or engineering. We might think of these as either being proto-forms of the disciplinary practices (Stevens, 2000b) or as McDermott (1998) has suggested take seriously that young people treat aspects of school as math or science. So rather than have students use the environment to play a scientist, engineer, or mathematician they will use the environment to play a *future* scientist, engineer, or mathematician.

Gee’s perspective, that the creation of a character within a game is a form of a projected identity, limits the kind of interactions one can have with the medium I am proposing. My view is that characters (and more generally speaking the profiles that players save in game systems) are a resource to be used in the broader project of building a successful academic career. From Gee’s point of view education often fails in that it

does not allow students to try out particular identities. Specifically he argues that students in science course would be better served if they were able to try out being scientists. My view is that in many ways students already do engage with science and mathematics and the game context can be used as a resource to understand how those activities relate to formal disciplines.

The use of characters in the environment I am proposing has an additional benefit in that the game can be used as a resource for the player to position themselves in the real world as someone interested in a STEM career. Recall that I used my ethnographic findings to suggest that the ‘identity work’ that occurs in the context of video games extends beyond the player’s interactions with the game and includes how the player uses the game as a resource to position themselves in the real world. This is present in how Vanessa spoke of the games she plays. Vanessa often selects games based on their narrative and imagined future she has for herself. For instance, she rejects her dad’s army games with the contention that she does not want to be in the military. On the other hand she is avid player of the Sims series and plays the *URBZ* where the object is to gain reputation in an urban environment. Vanessa claims that the *URBZ* “shows you what you have to do to build a reputation”, suggesting that she sees herself as someone that will socially interact in an urban environment. In her case, the relevant phenomenon includes how Vanessa uses the game to say who she might be in the future. She uses the game to suggest that she does not see herself as being someone that will join the military but would “rather stick to science or something”. In the real world there are plenty of options for Vanessa to use video games to position herself as someone interested in the military. However there are almost none that allow her to use games to position herself as

someone that wants to enter a STEM career. The environment I am describing is a resource that someone like Vanessa can use to position herself in the real world as someone interested in “science or something” and so the benefits may extend beyond her interactions with the game itself

Multidimensional narrative

Just as many video games allow players to pick story segments to assemble their own journey through the game, this particular medium will allow users to select different narrative sequences. Users will also have the ability to work in an open free-form type environment. Above I have described the narrative sequences as tasks, such as preparing to enter a STEM career.

Within this longer narrative of preparing to enter a STEM career there will be a variety of activities that the user can chose from. No specified order will be given to those activities (although some may be contingent on completing others) so the actual path a user takes through this narrative will vary depending on the activities that are chosen. For instance, a parent user might choose to have their character set up a space in the game that can be used by the student character to take things apart, an activity many engineering students describe as part of their early interest in the discipline. Alternatively they may enroll the student character in an after school activity geared towards introducing students to STEM careers. The student user then can engage with these new resources in a variety of ways.

Another possible narrative that could be worked through by both families and individual students would involve moving to a new school. This would involve activities that both the student and the parent need to accomplish such as making new friends,

finding information on after school activities, and meeting school staff and faculty.

Similar kinds of scenarios might involve designing a classroom or a study space in the home and preparing for college. Building off of my recommendation to provide a heterogeneous set of materials, narratives that begin in the game can involve activities that occur in the real world. For instance to complete the coming to a new school narrative the user might have to actually attend an extracurricular activity where a code is received which they enter into the system. Entering this code then influence the various quantities that the system makes use of.

Quantities: grades, currency, "reputation"

In real life quantities appear across school in a variety of ways. Most notably they appear as grades or scores on assignments. Credit hours and class time are other quantities that exist in school. There are other aspects of school that are less formally quantified such as after school activities and reputation or standings amongst teachers and peers.

College admissions offices have ways of quantifying young people's experiences in and out of school, this is one potential place to look for how to structure such a system. By doing this we potentially open up a process that has been closed off for many students whose families have little experience in dealing with these issues.

A complete list of the quantities involved in a final design is premature at this point, however as a starting point I will offer up three quantities: grades, reputation, and time. Grades will function in terms of individual courses and a collective average. Reputation will function across several dimensions such as standing amongst peers, teachers, and family. Time can be divided into two categories class time and

extracurricular activities. Each of these quantities will compete with each other as they do in real life and as they do in the game *Pharaoh* where Katarina encountered some persistent problems related to these quantities.

Bending the game

One potential way to allow users to bend the system would be to provide, through unofficial media, cheat codes that allow users to interact with various aspects of how the system works. For instance, one cheat code might allow users to raise their grades within the system for a limited time period. The purpose would be to show how the grade quantity interacts with other quantities in the system. Another scenario might involve having the student meet a secret individual in the game that has access to a college admittance office. The object would be to not only meet this person but also interact with them in such away that he or she would want to help the student out.

The free form mode might also contain a variety of hidden items that allow for subversive activities to result in lessons learned. For instance, imagine if the user in exploring the space was able to play a kind of prank on a teacher by moving objects out of the teacher's room. This action then could have implications for the student's reputation around school and the student's access to a variety of resources.

Heterogeneous set of materials

There are several ways in which a heterogeneous set of materials would be used in this system. Print material would provide users with a range of resources to use as they interact with the medium's tasks and free form activities. These materials would be produced by the users, possibly as in-class assignments, and by the games designers. Similar materials might appear online as well. This system should also exist in multiple

languages from the beginning, particularly Spanish and English, to help minority populations understand how the American school system works.

Conclusion

The five recommendations and the medium I have proposed have many potential uses and variants on those uses. I imagine this medium to be distributed by schools, community centers, and organizations that work with families in the context of academic achievement. The goal of this medium is not to improve content knowledge but to be used as a resource for navigating the complexities of school. Within given communities we might imagine how such a system could be used to seed knowledge of how school works.

On the development side the medium might also serve as means to provoke controversy amongst educators. It could be possible to allow an open creation of tasks based on the medium. This would be done by providing development kits for students and educators to build in their own ideas about how to be successful in school. One might imagine that this could lead to competing notions of school that literally get played out in families homes.

To recap, I have proposed five design principles from my observations of kids playing video games. They are making use of quantities, a multidimensional narrative, multiple modes of activity, heterogeneous set of resources, and allowing users to bend the game in productive ways. These design principles are intended as a way to think about how to make resources that students can use to assemble into their own learning process. Rather than suggest a constrained process that games use to guide players, I am suggesting they act more as adaptable resources. Video games contain many pieces that

players assemble and mobilize from their own purpose. It is the flexibility within the system that educators should build off of when thinking of how to best make use of kids everyday experiences to improve school.

Epilogue

In concluding this dissertation I will comment on the methodological strengths and weaknesses of the study. I will then revisit the three questions I used to organize the study: How do young people learn to play video games? What do young people bring to their game play? What do they take away from their game play?

The study's greatest strength may also be considered a threat to its validity. For the most part my findings are based on the play of four children: Johnny, Mikey, Vanessa, and Katarina. By focusing my analysis on four children, I was able to spend a great deal more time with each participant and develop a more detailed understanding of their gaming practices. This understanding is seen throughout the dissertation in the descriptions of their relationships with video games, the routines they used throughout their play, and their use of resources within the game context. By limiting the number of participants in the study, I was able to strengthen the validity of the descriptive analysis and so I am confident that what I have presented is an accurate representation of their play. The results of my analysis highlight the importance of considering factors beyond the number of participants, such as time, when interpreting a study's results.

The design of the study also made it difficult to observe emergent instances of game play. I consider emergent instances to occur during unexpected free moments of time. These were difficult to observe because my field visits were limited to scheduled occasions with the participants and their families. The participants mentioned these kinds of moments, such as playing handheld game systems while riding in the car; however, they did not have a significant role in my analysis. A follow-up study might consider how to account for these instances in the initial design.

The final weakness of this study is the lack of attention paid to psychological processes. Much of the analysis presented in this dissertation is based on Hutchins' (1995a) definition of learning as "adaptive reorganization in a complex system" (pg. 289). This definition, and Hutchins' approach to human activity, is not meant to ignore or preclude psychological processes as a part of understanding human activity. A follow up study might consider think-aloud tasks based on my findings to more explicitly draw out the psychological processes.

The first question this study was designed to address was: how young people learn to play video games. This question was designed to leave open the possible ways that young people interact with and learn to play video games rather than test a predetermined set of constraints that might influence learning. I also designed this question to leave open the degree to which players are active participants in the learning process that takes place in the context of video games. My findings indicate that learning in the context of game play is a co-constructed process between the player and the game. Both the player and the game are seen as active agents throughout the dissertation. For instance in the chapter titled *Making and Breaking Routines*, I described how the game's structure was adapted by the participants as they made their way through the game. The player's role in this process was to adapt the structure of the game for her own purposes. The game's role in this process was responding to the player's moves in the game. The learning process, as Hutchins describes, is distributed across the game and the player.

The second question was: what do young people bring to their game play? This question was designed as a means to better understand how video games fit into other aspects of the player's lives. In the chapter titled *Young Peoples' Relationships with*

Games I described some of the ways that family life influences game play. I also described how a player's interest in design influenced her play. I have shown that interests in video games are not separate from other aspects of life and that players bring in a variety of experiences to influence their game play.

The final question I used to organize the dissertation was: what do kids' take away from their game play? This question was intended to better understand how games find their way into other aspects of kids' lives. In the chapter titled *Young People's Relationships with Games*, I described how kids use video games to position themselves as people among their family members and their friends. I also described in the chapter titled *Playing with Representations* how video games set kids up to interact with science, technology, engineering, and mathematics that is analogous to what is commonly taught in school. My analysis has shown that game play becomes an experience that young people may potentially use to influence their activities in other contexts.

In the end these questions proved useful for the final chapter, *Games as Adaptable Resources*, because they allowed me to see the process as one where the players are active agents. This perspective lent itself well to the five recommendations that I used as the basis for the initial thoughts on a system that young people and their families might use to explore the complexities of school. Although my design is not an educational game that teaches specific content, this does not preclude the possibility that my findings can be used for that purpose. Regardless of what is taught from any designs based on my findings, the purpose should be that we avoid a perspective based on a separate worlds view and consider that the learning that takes place in the play context is not apart from or disconnected from other aspects of life.

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Appendix I – Sample Content Log

ReR

Field visit 4

TJS

Friday August 12, 2005 4:00-6:30

[00:00:08.16] playing the game Custom Robo this recording starts in the middle of a battle that ReR loses. (Just RR in this session. OR is in Germany.) (0-1, record)

[00:00:53.16] selecting different weapons for his robot. he pauses at a couple of points, to read the text? the menus have multiple layers that don't really make sense to me quite yet.

[00:02:21.11] a battle begins. two characters on the screen. one OR controls and one the CPU does. there is a timer at the top counting off in seconds. the battle begins with 120 seconds. he loses (0-2) before time is up. sighs when he does.

[00:03:52.04] goes through and changes his character again.

[00:04:57.14] battle begins. again 120 seconds. 2 character battle. he loses again before time is up. (0-3, record)

[00:06:34.24] says, ok under breath. and goes to selecting his character. he spends a few seconds on a few screens. i assume he is reading the text. this is starting to look like a pattern, ((m/s))

[00:08:04.03] another battle begins. same format. while in the battle he is quite and has a kind of blank face on. he loses the battle again with 63 sec left (similar amount of time in the previous one). (0-4)

[00:09:52.02] goes into character selection again. selects a character type. then color. then some weapons. then a pod. the pod has some kind of rating on the top (like 3/11). then he selects the legs. before the battle starts he can set a handicap on the opponent. he set it at 75% on this one (not sure what he did on the others) ((m/s)) ((manipulate))

[00:11:16.13] battle begins. same format. this battle lasts until there is no more time left. when it ends he says, "say i won" he did (1-4)

[00:13:37.26] a stat sheet ((m/s)) comes up.

[00:14:09.26] more character selection. selects body, gun, bomb, legs, can see his eyes moving back and forth when the screen pauses (evidence of reading?)

[00:15:44.23] another battle begins. this one is on a differt stage from the previous 5 battles. he loses the battle with 46 sec left. (1-5). ((snag))

[00:17:17.27] goes through character selection again. he does not handicap his oponite.
[one thought is to time selection process against the playing, my guess is that they are at least even or the selection process is longer]

[00:18:02.09] another battle. this is number 7. same format. he loses with 51 sec left. says "what?". (1-6)

[00:19:40.24] character selection again. does not handicap his opponite.

[00:20:31.21] the battle begins right after. this is number 8. i notice that on the bottom of the character is a small bar. indicating life. he wins this battle with 52 sec left. (2-6). the stat screen at the end tells him what his score was for each match.

[00:21:46.22] i ask him if there is a story that he is going through. he says that there was but that he had to go and re-do some of the tournament so he can get more trophies so he can get a class A license.

[00:23:46.15] goes into a menu screen called "stragegy novice" there is a lot of text that seems to give him hints. he goes through and reads some of them. ((resource)) this goes on for several minutes. something to pay attention to.

[00:25:30.14] comments that he doesn't remember how to save.

[00:25:42.11] most of the action now is happening in a 3-d space that he walks around in. no battles. he turns the game cube off to see if it save automatically. then turns it back on. it does. ((physical))

[00:27:32.24] starts playing a new game. Animal Crossing. His town is called RICHVILL.

[00:28:12.17] checks his mail and has several new unopened letters. he reads them and puts the gifts in his items folder.

his mom and i joke about getting irb for the dog.

[00:29:12.21] goes into his house and looks at some of the things he got in the mail then places them back into his items (he need to go into the house to do this).

[00:30:22.17] goes to the museum to donate the things he got in the mail. they were fossils.

gets up and asks his mom if she can make smoothies. he pauses the game by bringing up the item screen. ((pause-out)). while the game is paused his mom tells him he has to take a break (this is common) and he comes in to tell me that. i leave the cameras rolling when this happens.

[00:33:54.17] ReR comes in to ask me if I want a smoothie. i say yes.

[00:35:48.16] the door bell rings. RoR has a friend over. This is her mom coming to pick her up. JR refers the the study as a "summer job". they have some conversation which is in the back ground but because there is no game action this is on the tape. talk is about the weather, the R's recent vacation.

[00:39:09.01] ReR interrupts JR and asks if his break can be done. she says yes. he sits down and continues to play. the game had left off with him talking to the owl that runs the museum. he asks his mom what a "chambered nautilus" this is what the owl says the fossil is of. his mom does not know. ((m/s))

[00:40:45.10] in the back ground JR is telling the girls mom about the trip OR is on with their dad.

ReR gives the rest of the fossils to the owl then goes to check out what he has collected. It is all on display. he shows me that he has almost completed the T-Rex, just needs its head.

[00:42:20.02] leaves the museum and runs around with his fishing pole out.

[00:42:41.27] goes into the police station to look at the lost and found. there are three itmes. he does not take any of them.
talking is still going on in the background.

he leaves the police station then comes back in. looks at other items. but doesn't take any.

[00:43:49.11] when he leaves the lost and found travels around then looks at a map.
[00:44:00.19]

[00:44:17.26] gets his shovel out and digs up something from the ground.

[00:44:50.20] goes over to the water to go fishing. he catches a sea bass [remember OR didn't know how to fish]. he ask RoR if he had donated a sea bass to the museum. she says that he did. he goes to donate it anyway. the owl doesn't take it. (only one of each item in the museum)

[00:46:24.28] he walks around with his fishing pole and goes to see Baabra.

[00:47:09.11] then to the store (nook's). he tries on a shirt but doesn't buy it. looks at several other itmes. he doesn't buy any but has lots of bells 57,000 or so.

[00:48:45.10] leaves and walks over to the top corner and starts shaking trees. he
[00:49:25.23] finds a bag of bells. picks it up.
he doesn't shake the tree with pears in it.

[00:50:11.16] goes to his house. it has lots of items in it (almost full). he drops some of his itmes. tells me his house is really messy. that he had a fossil theme for a while but decided to dontate them. he tells me about his friends house which has many more rooms.

[00:51:41.12] he leaves the house and goes to the dump where he picks up some items.

[00:52:05.03] then off to the post office where he mails some letters. he does not make a payment on his mortgage. but finds out that he owes lots of money (134,000 or so) ((m/s)). he has 57.000. does some juggling of letters. sends one to the museum to mail his fossil.

[00:54:25.08] leaves the post office and collects some pears. tells me that the pears from his town sell for a lot in ORs. he also tells me that if you find a bag of 1,000 bells you can bury them and make a money tree. ((m/s))

[00:55:34.23] ReR and JR have a conversation about her playing video games. he doesn't have any that she wants to play.

[00:56:10.24] he goes to Nook's market.

[00:56:23.11] collects another pear.

[00:56:49.05] his item spaces are filled with pears.

[00:57:03.24] conversation continues about a game that JR wants to play. they seem to think that someone else took it. ((resource))

[00:57:40.19] game screen goes blank. changing the tape. ReR doesn't seem to be doing anything different while this is going on.

SESSION CONTINUED AT "RR_8-12combo2.inqscr"

Appendix II – Participant Screening Questions

Parents:

Introduce yourself by name and as a researcher on the Gaming to Learn project:

Thank you for calling to find out more about our research study. My name is <YOUR NAME> and I am a researcher at the University of Washington College of Education. Why don't I tell you a little bit about the Gaming to Learn project and you can let me know whether it is something you would be interested in?

Brief description of the project and procedure

We are doing this study to understand what children learn while playing video games. So, if your [child/son/daughter/name if known] were in this study, what we would do is come over to your house and watch him/her playing video games as he/she normally does. We would do this while you or another adult were home. And to help keep track of what we see we use a video camera to record people playing. We would also interview you one time and interview your child from time to time, probably three times. On occasion we might also ask your child to play a video game we bring over. The whole study will last about six months. The most we would come over in any week would be for seven hours, although it will be less than that for parts of the study. This would really depend on your schedule and our schedule.

Do you think you and your child might be interested in participating in this study?

[If No, end call] We do appreciate your calling to learn more about our study. Thank you for calling.

[IF YES] We have space for only a limited number of participants so we are currently keeping a list of interested kids. We will make final selections by the end of July. All parents will be notified whether or not their child is selected for participation in the study.

Permission to ask questions and statement of confidentiality

Before we can add kids to our list, we need to determine if they are eligible. I would like to ask you some questions about your child to make sure he/she meets the requirements for the study. Any information that I receive from you, including your name and any other identifying information, will be strictly confidential and kept in a locked file. Are you willing to answer some questions?

[If No, end call] *We do need the information before considering families as participants. If you change your mind, please feel free to contact us again. Thank you for calling.*

[IF YES] Complete the following page. (If caller is not a parent or guardian, do not collect information, request that a parent or guardian call.)

- ☐ What is the name of the kid that is interested in the study?
 - ☐ Is [name] a boy or a girl?
 - ☐ How old is [name]?
 - ☐ What is [name]'s ethnic background?
- ☐ How often would you say [name] plays video games?
 - ☐ How many hours per week?
- ☐ Are you or another parent usually home when [name] play's video games?
- ☐ How many people live in your house?
 - ☐ How many of them play video games?
- ☐ Do you know what video games [name] plays?
- ☐ Does [name] play on a Nintendo, X-Box, Playstation, or computer?
- ☐ Does [name] typically play video games with any brothers or sisters?
- ☐ Does [name] usually play video games with friends or other children or even any adults?
- ☐ In order to include times when [name] is playing with other children, we would need their parent's approval. Would you be willing to help us contact these parents?
- ☐ To help us understand whether or not [name] is eligible for the study we would like to ask [him/her] a few questions some other time. Mostly about what games they play, when they play them, who they play them with, things like that. We can do this either over the phone, by email, or chat. We even have an online survey they can fill out. Would that be OK with you?
- ☐ I'd like to talk to [name] about these different options. Is s/he available now?
 - ☐ [If not] What would be the best way and time to contact him/her? May I contact [name] directly?

Kids:

Hi, I talked your [mom/dad] and [he/she] said you really like to play video games and might be interested in our study. I'd like to ask you a few questions to help us understand what kind of games you play and stuff like that. This is so we get a lot of different kinds of kids in the study. OK?

- ☐ What games are you playing right now? (not RIGHT now but in general). How long have you been playing it? What are your top five games of all time?
- ☐ If you were to put together a wish list or a birthday list of games you want to play what would you put on there?
- ☐ Are there any games that you really do not like to play? What don't you like about those games?

- ❑ Do you rent games? Or borrow or trade games from friends?
- ❑ Do you have a console (x-box, ngc, or ps2) or do you have a computer that you play on? Or something else? Do you play online (or x-box live or whatever it is called for the ps2)?
- ❑ What room is the game system or computer in?

- ❑ Can you tell me when you play video games? Like what time of day? After school? After dinner? On the weekend?
- ❑ Do you play for a long time (like a few hours) or just less than that each time you play?
- ❑ Do you play with friends or other kids or bothers or sisters? Well, what games do you play with other people? And how does this work? Is this at your house? Or your friend's house? Is the game one player? Or multiplayer? Are you playing against each other or working together? Are there certain times or days that you tend to play with other kids?
- ❑ Do you talk about video games with other kids at school? At recess? Lunch?

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Curriculum Vita

Education

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Research Interests

Socio-cultural perspectives on cognition, learning, technology, and interaction.
 Analysis and design of learning technologies and contexts. Diffusion of
 educational innovations. Mathematical practices in everyday environments.

Dissertation Topic

My dissertation is a detailed ethnographic look at the everyday video gaming practices of children. It examines how kids learn to play video games, what they bring to their game play, and what they take away from it. Particular attention is paid to the mathematical and scientific competencies children develop and utilize in these environments.

Publications and Presentations

Satwicz, T. (2006, April 17). Technology and learning at play: An ethnographic study of young people's video gaming practices. Invited presentation to the Learning and Performance Support Laboratory at the University of Georgia. Athens, GA.

Satwicz, T., McCarthy, L., & Stevens, R. (2006). Gaming to learn what? An ethnographic study of kid's video gaming practices. Paper presented at the 2006 Annual Meeting of the American Educational Research Association, San Francisco, CA

Satwicz, T., McCarthy, L., & Stevens, R. (2006, March 20). Technology at play: An ethnographic study of young people's video gaming practices. Invited presentation to the Images of youth: New directions in media literacy and teen health conference. Seattle, WA

Satwicz, T., McCarthy, L., & Stevens, R. (2005). Sketching the practice: Game problems and player resources in gaming studies. Poster presented at: Games, Learning, and Society 1.0; June 23-24 2005; Madison, WI.

Bell, P., Stevens, R., & Satwicz, T. (Eds.). (2002). *Keeping learning complex: Proceedings of the Fifth International Conference of the Learning Sciences*. Mahwah, NJ: Lawrence Erlbaum Associates.

Satwicz, T. & Stevens, R. (2004). Comparing conflicting perspectives on a diffused technology. In Y. B. Kafai, W. A. Sandoval, N. Enyedy, A. S. Nixon & F. Herrera (Eds.), *Embracing diversity in the Learning Sciences: Proceedings of the Sixth International Conference of the Learning Sciences* (pp. 632). Mahwah, NJ: Lawrence Erlbaum Associates.

Works In Progress

Satwicz, T. & Stevens, R. (in preparation). *From project to object and beyond: Understanding the diffusion of a learning technology in higher education*.

Satwicz, T., McCarthy, L., & Stevens, R. (in preparation). *Playing with representations: How do kids make use of quantitative representations in video games?* Unpublished manuscript.

Satwicz, T. & Stevens, R. (in preparation). People, technology, and learning: A distributed look at collaborative activity. In J. M. Spector, M.D. Merrill, J.J.G. van Merriënboer & M.P. Driscoll (Eds.), *Handbook of research on educational communications and technology* (3rd ed.). Mahwah, NJ: Erlbaum.

Stevens, R. & Satwicz, T. (in preparation). *Comparing the mathematical practices of engineering across school and work*. Unpublished manuscript.

Stevens, R., Satwicz, T., & McCarthy, L. (in preparation). *In game, in room, in world: Reconnecting video game play to the rest of kids' lives*. Unpublished manuscript.

Professional Positions

- 9/04 – 6/06 *Research Assistant:* NSF funded LIFE (Learning in Informal and Formal Environments) Science of Learning Center, Prof. John Bransford (Principal Investigator), Prof. Reed Stevens (Supervising Faculty). Ethnographic research on informal learning. I have helped design and participate in research projects that analyze learning in informal settings. This often involves video recording everyday activities and technology use to understand how people learn.
- 9/03 – 9/04 *Research Assistant:* NSF funded CAEE (Center for the Advancement of Engineering Education), Prof. Cindy Atman (Principal Investigator), Prof. Reed Stevens (Supervising Faculty). Ethnographic research on mathematical practices across school and work.
- 9/01 – 8/03 *Research Assistant:* PETTT (Program for Educational Transformation Through Technology), funded internally through the University of Washington, Dr. Rick Matsen (Principal Investigator). Ethnographic research on technology use in higher education. I participated in the design of an electronic portfolio tool then followed its use in two undergraduate classrooms.
- 12/00 – 9/01 *Research Assistant:* NSF funded PRIME (Partnership for Research in Inquiry-based MSE Education), Dean Denton (Principal Investigator), Prof. Reed Stevens, Prof. Philip Bell, and Prof. Elham Kazemi (Supervising Faculty). Support for ethnographic research on teaching partnerships.
- 8/98 – 6/00 *Elementary Science Teacher:* Bellevue School District, Bellevue WA.

Dissertation Committee Members

Prof. Reed Stevens (Chair), College of Education
 Prof. Philip Bell, College of Education
 Prof. John Bransford, College of Education
 Prof. Kirsten Foot, Department of Communication

Conference Service

Reviewer for the Seventh International Conference of the Learning Sciences (ICLS 2006).

Reviewer AERA 2006. Division C Educational Technology, Education Science and Technology SIG, Informal Learning Environments SIG.

Reviewer for Computer Supported Collaborative Learning (CSCL) Conference 2005, Taipei, Taiwan.

Conference Coordinator for the Fifth International Conference of the Learning Sciences (ICLS), "Keeping Learning Complex: Fostering Multidisciplinary Research," 2002, Seattle, WA.

Educational Designs

School Leader Development: Building 21st Century Schools

Supported by and developed for Microsoft Partners in Learning. This is a CD ROM-based curriculum used to help school leaders around the world rethink schools for the 21st century.

Catalyst Portfolio Tool

This is a web-based portfolio tool developed internally at the University of Washington that allows students to collect and annotate digital artifacts. Instructors are also able to assign projects and comment on student work.