CREATING ENTERTAINING GAMES WITH EDUCATIONAL CONTENT: CASE STUDIES OF USER EXPERIENCES WITH THE CHILDREN'S WEBSITE, *FOOD DETECTIVES FIGHT BAC!*®

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By
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Abstract

This study reviews the gaming and entertainment preferences of 5 children ages 8 to 12 as they use a children's website on food-borne illness — *The Food Detectives Fight BAC!*® Children were observed while using the website and were interviewed regarding its use. Qualitative analysis of the observation yielded case studies of two boys and three girls revealing use preferences and game characteristics that children consider "fun." Cross case analysis revealed themes in children's attitudes and preferences as well as recommendations for development of game-like educational websites for children. Suggested development guidelines include preferences based on game play, control, feedback, usability and interface design. Findings hold implications for developing educational games and software in revisiting Thomas Malone's question, "What makes computer games fun?"

Leadership, Foundations and Policy

Curry School of Education

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APPROVAL OF THE DISSERTATION

This dissertation, *Creating Entertaining Games with Educational Content: Case Studies of User Experiences with* The Food Detectives Fight BAC!® *Children's Website*, has been approved by the Graduate Faculty of the Curry School of Education in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

Dr. Mable Kinzie, Advisor

Dr. Glen Bull

Dr. John Bunch

Dr. Robert Covert

_____Date

Dedication

This work is dedicated to my family, especially my parents, who have always thought there was nothing I couldn't do; my husband, CC, whose support, love, and patience makes everything I do possible; and my friend and mentor, Jeanne Gleason, who introduced me to this field and put the idea of a doctorate in my head in the first place. I owe each of you so much more than a 149-page paper. Please accept this dedication as a down payment on lifelong gratitude.

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The website on which this research was based reflects the work of many people. I especially appreciate the contributions of **Dr. Jeanne Gleason** and **Pamela Martinez** in developing and maintaining the site. Jeanne has served as my boss for many years, and supervised development of the site, enabling my involvement in its production. Jeanne's

support introduced me to this field, and taught me so much of what I know about instructional design. Pamela is a good friend, who has shouldered a tremendous amount of responsibility and hard work while I have focused on my school work. Thank you both for your professional and personal support. Additionally, the *Food Detectives* website reflects the talents of many people at UVA, as well as at **New Mexico State University** and U.S. Department of Agriculture. For those of you who contributed and worked so hard, thank you for developing a project that was so much fun to do research on.

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Table of Contents

List of Tables

CHAPTER 1

INTRODUCTION

Reflective Narrative: Inspiration for This Research

The challenge for our development team was to create a website that was fun, was full of games for kids, and taught basic food-safety concepts. As the team, we were not challenged to develop higher-order thinking strategies, model problem solving or even mental dexterity — we wanted to teach kids when they should wash their hands, how long leftovers could be out, the importance of cooking food. This challenged us because we could not imagine kids would search out this information on the Web voluntarily. Our research told us parents usually are not aware that they themselves do not know this information, so parents probably would not direct their kids to find this information. Teachers may not include this information in their classrooms. However, we knew kids liked to play games on the computer: we envisioned a site that kids would play in their free time *only because it was fun*, while being exposed to the educational nuggets we thought were important.

During some of our early assessment of the site, I watched a girl, 13 years old (even older than our target audience) completely engaged in the site. She did not have to continue using it: it was voluntary. She could have used her time to explore the website of her favorite rapper, or download music at another location, neither of which contained educational messages. Instead, she was content to continue using *The Food Detectives Fight BAC!*® site — telling me she would recommend it and share the URL with friends.

She was able to give me examples of what she learned while playing. An important revelation filled my head: if I wanted to *educate* children— especially about simple content knowledge – I could take advantage of their game-playing free time. Knowing how to share knowledge in an educational manner was only part of the equation: I needed to understand how to *entertain*. I wanted to put my thumb on what kinds of computer play kids enjoy as a starting point for future educational designs.

Rationale and Purpose

Is there room for educational websites that children seek out for their entertainment value? If an educational website is not required reading for kids, what characteristics must it have to attract and keep kids' attention? Do educational content or conventional instructional methods have to be sacrificed to create a site kids will enjoy using?

In the early 1980s, Thomas Malone (1983) launched a field of inquiry when he asked the question, "How can the same things that make computer games captivating be used to make *learning* with computers more interesting and enjoyable?" Have new game technologies, programming capabilities, and the Internet made game play at the turn of the century different than it was 20 years ago? This research contributes to the field by offering case studies of the use of an educational and entertaining website: *The Food Detectives Fight BAC!*® What elements make it appealing to kids? What aspects of other gaming and game-like activities do children in this age group enjoy? The answers to these questions have implications for the development of future sites designed to share educational information through engaging game play.

Potential Significance

As an instructional designer for children's media, I have typically begun my design approach by identifying the cognitive and intellectual abilities of my target audience and reviewing the popular games sold for my audience's age group. While I still believe in considering users' cognitive abilities, I am no longer content with simply analyzing what sells well: I am interested in uncovering the attitudes and beliefs about *why* a game is fun. I want to identify key elements that are attractive to kids so that I am better able to design a game-like educational experience. I designed this research as an in-depth review of the opinions, beliefs, and behaviors of kids related to educational game sites. In the process of sharing these case studies, I believe the field of theory and research will be advanced as researchers in instructional design continue to ponder Malone's original question within the framework of new games and gaming environments. In a way, this research is summative in analyzing the Fight BAC!® website, yet formative in revealing design implications for educational entertainment.

My interest in this line of research extends beyond the Fight BAC!® website. Academically, I am hungry to get at the nature of what children enjoy about *all* gaming sites. I want sound research that reveals and confirms gaming producers' secrets for creating sites that "stick" with game players. Some theories have been established, but research on gaming preferences is only now begin to emerge in the field.

I do not have the resources to do a large-scale, in-depth study of all the games available on the Web. Focusing my research on the existing Fight BAC!® website offered the advantage of manageable resources in analyzing a site I am familiar with, and a scope

that was assessable within a year. The site offered one constant among all users, aiding in the analysis of data and analytic induction.

While the qualitative nature of case studies prevent generalizability to a larger audience, they help to create a deep understanding of individual use of the site. The reasons individuals find parts of the site entertaining or boring can speak to a designer who is creating a new game or educational activity. More than just knowing whether one type of game is enjoyed, the designer can understand why the game is fun, and design future products with those elements in mind.

Perspectives and Background of the Researcher

My knowledge and skills in instructional design complement my interest in reviewing literature in the field. I have been intimately involved with *The Fight Detectives Fight BAC!*® project from its inception: assessing needs, conducting the preliminary research, and leading development, as well as conducting formative assessment. My familiarity with the field of instructional design, as well as intimacy with this project, increases my perception of use of the site. I am more likely to notice where a user is pausing in a site, because I know exactly what text is on that screen. I have seen many children use the site and understand how long it takes the average child to read the instructions for one particular game. I have learned to recognize disinterest in a child who begins listening to a song. I have also spent a great deal of time reviewing children's games and websites. If a study participant mentions her favorite site, I am likely to have seen it or have a familiarity with the concepts behind it. I have been involved in the

development of several children's games, websites, and other learning resources. While this familiarity certainly presents challenges, it speaks to my competence in assessing the site and preparing the case studies. Challenges relating to my familiarity with the site, as well as ethical issues in conducting the research, will be addressed in the methodological section.

The Food Detectives Fight BAC!® Website Educational Objectives and Design

The Food Detectives Fight BAC!® website has been designed to share food safety knowledge with students in a key age group — 8 – 12 years old. Food preparation and consumption behavior begins in this age range, as children prepare snacks, reheat leftovers, clear the table, and assist in the kitchen.

Children are especially vulnerable to food borne illness. The Centers for Disease Control and Prevention estimates that "food borne diseases cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the United States each year" (Mead et al., 1999). Yet these illnesses and deaths are preventable through proper food safety procedures. Knowledge of these procedures are key to preventing illness, and three quarters of Americans are still "getting it wrong" when it comes to food safety (Daniels, Daniels, Gilmet, & Noonan, 2000).

The United States Department of Agriculture placed a priority on educating children in food safety by funding development of *The Food Detectives Fight BAC!*® website. Evaluating the site addresses the effectiveness of the site in meeting its educational goals; however, an unexpected success may be found if children who would not normally seek

out food safety information look for a game to play, use the website, and receive food safety education in the process. Therefore, this research identifies what aspects of the site kids enjoy using.

The origin of the website lies in a United States Department of Agriculture request for proposal on food safety education. The funded proposal specified the development of computer/Web-based educational games, interactive activities, and songs that conveyed the dangers of food-borne illnesses and preventive measures. In developing the program, I conducted a needs assessment evaluating what was known about food safety research, behavior assessment, and existing computer or web resources on the Fight BAC!® food safety awareness program.

Based on extensive focus group testing and research, the Partnership for Food Borne Illness Education developed the Fight BAC!® campaign around four key messages – cook food properly; clean surfaces, utensils, hands, dishcloths, and food; chill food, as needed, to the proper temperature and within the necessary time limits; and separate raw meat and juices from cooked meat and juices (*Fight BAC!*™, 2002). Initial consultations with child development and food safety experts indicated children in the 8 to 12 year age range are most likely to benefit from the cleaning and chilling aspects of these educational messages, as they begin food preparation practices with parents, clear the table, put away leftovers and start spending time in the kitchen. With the consent of members of the Partnership for Food Borne Illness Education, these educational objectives were altered for the website audience so that the user understands the following:

1. Which situations require hand washing, either before or after.
2. Proper hand washing procedures, including length of time.
3. Length of time leftovers can be left out.

4. How to kill bacteria by cleaning properly and cooking to the proper temperature and how to slow bacteria growth by chilling food.

I worked with a team of four additional instructional designers, artists, programmers, content specialists, and youth development specialists to brainstorm initial game ideas. After initial ideas were developed, simple concepts were tested with children by discussing ideas with them, showing them graphic representations of the games, and sharing song lyrics. As games were developed, children were consulted in the development process, playing early versions of the game and giving feedback relating to the appeal, playability, and entertainment value of the site. Throughout the development process, this formative evaluation was key in changing games and in developing new games.

The Food Detectives Fight BAC!® website is accessible online at http://www.fooddetectives.com. Screen shots from the games as it looked for this study are included in the Chapter 5, *Cross Case Analysis*. The site includes:

1. **Introduction to the Food Detectives characters:** Participants meet each of the cartoon characters: Fridge the refrigerator, PT the roll of paper towels, Ima Basin the sink, Slick the pump soap, and Thermy the digital thermometer.
2. **The Case of the Kid Who Knew Enough**: In this sticker-making activity, users are encouraged to share their food safety knowledge with others in their homes by creating educational stickers and signs. Users select text messages, pictures, borders and backgrounds for their creations.
3. **The Case of the Good Food Gone Bad**: This classic game of concentration offers food safety tidbits with each match, as well as occasional jokes about food. The number of tries it takes to clear the board is noted after each game.
4. **The Case of the Filthy Fingers**: An introduction offers information on when hand washing is needed and when it is not. Participants then follow a time line,

noting the different activities (such as going to the bathroom, playing basketball, and preparing a snack) and decide each time hand washing is required. The game changes each time it is played, and participants try to beat the clock when making their decisions.

5. **The Case of BAC That Kept Growing**: Similar to the classic "shoot 'em up" games in arcades, Users shoot and kill moving bacteria with flames (heat) or with soap bubbles. Users can use an ice cube to temporarily freeze the bacteria and keep them from moving. Users have to kill the majority of the bacteria in a set amount of time before moving to the next level.
6. **Certificate Making Activity:** After successfully solving each of the cases, participants are granted access to this activity and encouraged to create their own certificate of completion by selecting a background, word blurb, border, and graphic.
7. **Fight BAC!® TV**: Participants select from five songs and animations introducing the food detectives, introducing the Fight BAC!® concept, conveying the importance of chilling and cooking foods, and providing a 20-second song as a guide for singing while washing hands. Words to the songs appear for those wishing to sing along.

A **Grown-Ups Page** is available to participants but directed towards adults. This page encourages adults to learn with children. The key Fight BAC!® concepts are outlined and additional learning activities are provided. (Because this part of the site has not been designed for children, it will not be included in this assessment.)

Research Questions

In analyzing game-like educational activities, with *The Food Detectives Fight BAC!®* website as a base, this research answers questions in three general areas:

1. What aspects of *The Food Detectives Fight BAC!*® website are considered entertaining to users? What components of the other games and activities in the site are considered boring or do not engage the user?
2. What aspects of other preferred games could be implemented in the Fight BAC!® site to increase enjoyment?
3. What educational messages do users glean from the site?

These questions are addressed through qualitative data obtained from observation and interviews. The result is a detailed case study of each participant with cross case analysis regarding game play within the Fight BAC!® website, as well as emergent themes in game preferences. Evidence of learning is presented in each cross case and summarized in table form.

There appears to be some disagreement in the literature regarding what components make a game. Many writers suggest games must include a competitive or challenging element, that the mere completion of an activity is not a game (Dempsey, Lucassen, Gilley, & Rasmussen, 1993; Dempsey, Lucassen, Haynes, & Casey, 1996; Dempsey, Lucassen, Haynes, & Casey, 1997; Malone, 1980, 1981, 1983). Others do not specifically require competition (Amory, Naicker, Vincent, & Adams, 1999; Jones, 1999), or they identify games without specifying components that make them games versus another educational activities (Char, 1983). Others simply rely on research subjects' judgment in identifying or self-reporting on game activities. (Buchman & Funk, 1996; Downes, Reddacliff, & Moont, 1996; Harris, 1999; Miller, Schweingruber, & Brandenburg, 2001; Mumtaz, 2001).

While this may be an argument of semantics, it is also one of classification. I do not feel that specifying the components that make an activity a game for children is

appropriate. I would like children to make their own determinations. The web presents diverse entertainment options, including passive viewing of animation, creative artistic and writing opportunities, and more traditional competitive and challenging games. In discussing gaming preferences with children. I relied on their judgment in determining what a game is. For example, in *The Food Detectives Fight BAC!*® site, two activities present a creative environment in which participants can develop their own stickers and certificates. There is no right or wrong answer, and users are actually creating product, as opposed to simulating creation of it. Though this activity does not fit some of the game definitions given, users of the site may well consider it a game. I will include components of their discussion in my analysis of gaming preferences.

Methodological Justification

The literature in Chapter 2 reviews several theories and articles on game design, the role of play in learning, and entertainment factors in games. Several research articles assess general trends in preferences, such as types of games preferred, gender differences in computer and game use, and several propose elements of popular game play. However, assertions in published research tend to address these preferences without describing attitudes and opinions that lead to those preferences. For example, Buchman and Funk (1996) documented the time commitment and preferences of 900 fourth through eighth grade students by asking participants to self-report their favorite games. These games were then categorized and ranked according to preference. While indications speak to general preferences for game play, the research does not explain *what* components of

educational games (the least favorite in all categories) were found to be boring, or *how* components of general entertainment games led to entertainment.

My interests lie in the *how* and *why*. Qualitative research does not strive to predict or control, but to gain understanding of participation (Behrens & Smith, 1996). As Eisner (1991) summarized, “Interpretation pertains to the ability to explain why something is taking place.” Eisner’s “Primacy of Experience” allows instructional designers “to see” into the mind of the website user, better predicting games that will be enjoyable.

I believe in-depth review of an individual speaks to reasons behind behavior: revealing recommendations for game design that allows for a variety of game preferences without attempting to identify one standard approach for all users. Rather than identify the preferences most common among all users, qualitative research can address why preferences exist. For example, when reviewing preference for instructions at the beginning of the game, preferences could be quantified in asking how many users want or use written instructions and how many do not. However, a small-scale qualitative analysis addresses *why* users want or use instructions. The game designer may be better able to provide written instructions that are optional for some or audio instructions for those who prefer hearing them. Case studies reveal that preferences can be context sensitive: some games may feel so familiar to some children they do not need or want instructions, while other children may not be familiar with the genre. Instructions may not be needed at the beginning of the game, but may be necessary as users progress. Adventure games often scaffold their instructions, providing information on a need-to-know basis — for example, a training room that is always open. Much of the instructions given happen in such an exploratory way, users may not be aware they are receiving

instruction. For example, the first time a player pulls a lever, they see a gateway open: from that point, the player knows to look for a lever if a gate needs to be opened. Further, instruction can be offered as a reward or motivation: secret key combinations revealing passages or jumping sequences are introduced after proceeding through a difficult activity.

Even in the seemingly simple task of receiving instructions, complexities can be revealed through understanding. This *how* and *why*, when addressed through in-depth analysis, can help develop flexible games for *a diverse group* of users, rather than one set structure for *most* users.

Qualitative methods also clarify what is learned by participants using *The Food Detectives Fight BAC!*® website. For a preliminary pilot study on the site, I struggled with quantitative methods for evaluating knowledge gain. Particularly in areas of hand washing and appropriate behavior, I had difficulty drafting questions that did not indicate the correct answer simply in the phrasing of the questions. Open-ended questions yielded answers that, though not incorrect, did not truly speak to the educational message. For example, one test question asked users of the site to identify two ways to kill bacteria (heat — cooking to the proper temperature — cleaning). One early respondent answered "washing my hands" and "taking a bath." While neither of these is incorrect, the answer does not indicate that the participant did not actually know both answers. Instead of utilizing quantitative pre- and post-tests to measure knowledge gain, I utilized these questions as a starting point for a verbal interview, allowing follow-up to better understand the scope of the Web users knowledge following up on answers that needed elaboration.

Limitations

"No proposed research project is without limitations" (Marshall & Rossman, 1999). I understand that the qualitative nature of the case studies presented give only a glimpse into the preferences of those I interviewed. There may be preferences and entertaining components of games that some game players enjoy, even though the children I interviewed do not.

This research is not an in-depth, comprehensive review of all the elements that make game play enjoyable to children. Analysis is based on my observations of the participants and my interpretations of interviews. Through review of my methodology and transcripts of sessions, I identified some bias in the results and removed such comments from the case studies to the satisfaction of peer reviewers.

Finally, this is a case study of 5 participants. Kids of both sexes have been included, and it has focused on use during the free time of kids at computers with fast Internet access. Also, because developmental differences exist among children of the same age, feedback from study participants most likely does not represent the opinions of all children of the similar age. This study may not adequately speak to the differences between the sexes or as a function of use in different environments or hardware settings.

CHAPTER 2

LITERATURE REVIEW

The *Food Detectives Fight BAC!*® website is unique in that it has not been designed as merely an *entertaining* game, nor a strictly *educational* game. *Entertaining* games are generally not expected to be *educational*: children can pass the time with a computer game and lose themselves in the engaging fun. Similarly, educational games can be fun, but kids may have lower engagement expectations. For example, when a child uses a computer game to learn mathematics, she may think it is less fun than racing rocket ships with Jimmy Neutron on his online website, but she probably enjoys it more than practicing her times tables using flash cards.

The *Food Detectives* games have simple educational objectives — participants are not expected to engage in higher order thinking skills, construct their own knowledge or engage in inquiry-based learning: the site was designed to expose kids to the simple Fight BAC! concepts. Additionally, the content is generally not required in school curriculum, statistics show it is not adequately taught in the home (Daniels et al., 2000), and 8 to 12-year-old children probably do not find food safety inherently fascinating. Because of the content simplicity and lack of appeal to the target audience, the *Food Detectives* design team was less concerned with learning theory in computer games and more interested in children's gaming preferences. While researchers in constructivist computer games recommend self-directed learning, reflection and self-initiated future study (Issing, 1994), the larger challenge for the *Food Detectives* development was in getting users to play the game in the first place. Assuming potential users would be attracted to a computer game

that was fun, the most relevant research speaks to developing games users would be attracted to for entertainment purposes, while still learning necessary content.

This study begins with a review of the concept of "play" and the importance of engagement and motivation in the perception of "fun." In applying these concepts to game development, themes in what makes a computer game "fun" are reviewed, as are guidelines for developing computer games.

What Is "Play?"

Rieber's (1996) research led him to conclude that play has four attributes: it is usually voluntary, it holds intrinsic motivation (the act itself is enjoyable), it involves active engagement, and it contains a make-believe quality. Amory et al. (1999) reviewed work of several research studies to conclude that play performs an important role in childhood, "specifically as a voluntary, intrinsically motivating force." Games are thought to fill the role of a self-motivating and rewarding activity — a "universally accepted mode of learning." The themes of intrinsic motivation, voluntary engagement and fantasy elements echo Garvey's (1990) five descriptive characteristics of play, which she puts forth as "widely cited" elements in the definition of play: Play is pleasurable, play has intrinsic motivation, play is spontaneous and voluntary, play involves active engagement and has "systematic relations to what is not play" (p. 5) — play is related to non-play activities such as learning. These five descriptive characteristics provide a structure for a review of the ways in which computer games serve as a vehicle for play.

Play Is Pleasurable and Enjoyable

Anecdotal evidence certainly supports the assertion that computer games are pleasurable and enjoyable for children: ask any parent if his or her child enjoys computer games and you will likely hear an emphatic "yes!" Use statistics also indicate that computer games are pleasurable for kids. Buchman and Funk (1996) documented game playing behavior of 900 fourth- through eighth-grade children and found approximately 90% of fourth graders reported playing one or more hours each week on computer games. This 1990 study pre-dates active, voluntary involvement of youth on console-based games at home. Harris (1999) found 85% of the time students spent in voluntary use of computers in the home was spent on games and adventures. Mumtaz's (2001) more recent study found that 85% of children enjoyed playing computer games on their home computer, demonstrating more satisfaction with home computer use than school computer use, where computers were more frequently associated with tasks than with play.

Play Is Based on Intrinsic Motivation

Rieber's (1996) interpretation of play is that by offering intrinsic motivation, play is pleasurable. Garvey's definition separates the two, maintaining that play is pleasurable and enjoyable, and also that the intrinsic motivation component of play means that children play solely for the sake of playing. The theory of intrinsic motivation is that simply engaging in an activity has appeal to an individual due to a personal interest in the activity (Rezabek, 1995). Kinzie's (1990) review of educational research on motivation suggests that instructional design incorporating learner control and self-

regulated learning reflects the user's interests and intrinsic motivation. The control, relevance, and perceived competence blends with users' curiosity to positively impact their continuing motivation, that which prompts students to return to an activity based on their intrinsic motivation.

In their literature review updating Malone's theory of intrinsically motivating instruction, Dempsey et al. (1993) concluded that games result in significantly higher levels of motivation, reduce training time, and may improve retention of what is learned. Gredler (1996) acknowledged that research in assessing the direct effect of games on education is flawed by a lack of design principles relating to learning objectives (some activities labeled as a "simulation" may not really be simulations) and a lack of well-designed research studies. Reiber (1996) concludes that games represent the instructional artifact most closely matching the characteristics of intrinsically motivating learning environments: challenge, curiosity, fantasy and control.

Play Is Spontaneous and Voluntary

Game use statistics previously mentioned speak to the voluntary nature of computer game use by children. More importantly, when educational objectives are well blended with computer games, attainment of educational outcomes can be combined with voluntary participation in play. Studies by Buchman and Funk (1996), Harris (1999), and Mumtaz (2001) demonstrating computer use as pleasurable for children reflect the voluntary use of computers in the home. In Mumtaz's study, children reported greater satisfaction with voluntary computer use (most frequently for game playing) than school use, in which 92% of students reported feeling bored. Interestingly, spontaneous and

voluntary use of computers may differ by sex, with girls reporting more use of email and word processing and boys reporting greater voluntary play in games. This study did not consider use of console-based video games.

Play Includes Active Engagement

Jones (1998) returns to the concept of intrinsic motivation to define engagement. He promotes the idea that the initial and continued interest in a computer-based program results in active engagement. Csikszentmihalyi's (1993) flow theory defines the optimal state of "flow" as the point where skill and challenge meet — where the activity is engaging because it meets the skills and needs of the participant. Computer games support the eight major components of flow: tasks that can be completed by the player, opportunity for concentration on a task, clear goals, immediate feedback, deep but effortless involvement, control over actions, decreased concern for self with stronger sense of self following activity, and a distorted sense of time (Jones, 1998). Educational computer games can sustain active engagement in game activity through seamlessly integrated content with game play — as stated in Rieber's proposition, in ideal learning environments, content and structure are so closely related "one cannot tell where the content stops and the game begins" (1996, p. 50).

Play Is Related to Non-Play Activities

Games may also serve many functions: tutoring, amusement, exploring new skills, promoting self-esteem, drill and practice, or creating a change in attitudes. (Dempsey et

al., 1993). Games are meant to be entertaining, not instructional, with incidental learning (Dempsey et al., 1996). Games serve as a vehicle for play and imitation, appeal to children by asking them to do what comes naturally, generally offer complex sets of properties, assist children in invoking a set of "mindfulness" (creating knowledge that is meaningful and useful), and can act as a sociological agent (Rieber, 1996).

After redesigning a "discipline focused" curriculum for a school district emphasizing thematic units, teachers in a study by Henderson, Lemes, and Eshet (2000), incorporated a CD-ROM microworld simulation in their classrooms. Results of the module indicated improvement in thinking skills and strategies, recall, classification skills, inference, and use of scientific language. Researchers emphasize that incorporation of the multimedia element with classroom interaction was key in successful implementation and that the game element should be used in combination with other contexts for learning.

With established connections between play and computer games, the question is not *if* computer games are forms of play, but "*what aspects of the play experience are fun?"*

What Makes Computer Games Fun?

In asking Malone's question, "What makes computer games fun?" at the turn of the new century, we must acknowledge that new circumstances exist: graphics are more realistic, game players are more experienced in computer game play, simulation and complex computer interactions are more easily programmable. Yet, throughout the past 20 years, gaming preferences have remained amazingly consistent with Malone's observations of 20 years ago (Dempsey et al., 1997).

Key Theories in Game Development

Malone's initial theory (1980) includes three game categories: challenge, fantasy, and curiosity. While any one game is not required to include aspects of all three categories, each heightens enjoyment. Challenge includes granting the user uncertain outcomes, obvious and personally meaningful goals, and varying and appropriate difficulty levels. He also encouraged the use of randomness and a sense of discovery for the learner, advising that goals and challenges can enhance the self-esteem of the user, lowering it if the expectations are inappropriate. Fantasy includes extrinsic fantasy, in which the users' actions determine what happens in the game, and intrinsic fantasy, in which the fantasy provides feedback as well to the user. Curiosity yields from environments that are neither too complicated nor simple, with appropriate graphics, music and animation. Surprise and increasingly complex tasks also encourage curiosity (Malone, 1983).

Smith and Keep (1986) advise, "it is most improbable that any agent could be equally motivating to *all* learners, and attribution of general motivational effects to the computer seems misguided" (p. 83). They asserted that beyond the attributes of a game, involvement of learners in their own learning is motivational. Jones (1998) concurred, believing that if the learner is motivated from within to learn, simply presenting the information is engaging. While these findings speak to the nature of engaging learning, they may not reflect directly on game play.

Thiagarajan (1996) offers five critical characteristics: conflict, control, closure, contrivance and competency base. Conflict is similar to Malone's challenge, including cooperative attainment of a goal with others, or competition with scores, the computer, or

other players. All games have rules that regulate play and offer control, and these rules vary in complexity and flexibility. Closure reflects the "end point" of a game. Thiagarajan contends that effective educational games use multiple criteria for closure. Contrivance keeps players from taking games too seriously, offering playfulness and motivation to continue. Finally, competency base allows players to develop and grow in their skill level, knowledge or problem solving skills.

Children's Preferences in Computer Games

Gender-based differences. A large body of research indicates that boys and girls view computers differently and prefer different activities (boys prefer games and girls prefer communication or creative activities), and that boys spend more on the computer than girls. However, recent research indicates that these gaps are narrowing (Rocheleau, 1995). More recently, Wartella, O'Keefe, and Scantlin (2000) attempted to summarize sex differences in computer interest, game use, and preferences through analysis of research in the field. They agreed that gaming is the most common use of computers by children of all ages, though boys report more use than girls. They also concur that content interests are different: boys prefer violent action and sports, whereas girls prefer educational, fantasy-adventure, puzzle or spatial relations games.

A growing consensus among researchers indicates that sex differences seen in previous research will change dramatically as games are developed specifically for girls and access for users of both sexes increases. As more games and activities include activities girls prefer, such as games based on reality and creative play (Subrahmanyam,

Kraut, Greenfield, & Gross, 2000) and arcade/simulation games (Miller et al., 2001), boys and girls may use games in equal duration and frequency. The National School Board Foundation (2000) surveyed 1,735 randomly chosen households with children ages 2-17 in March 2000 and found that boys and girls use of the Internet is equivalent, breaking the myth that girls are technology-phobic. The survey does reinforce research that boys and girls use the Internet differently, with boys more likely to seek entertainment, and girls more interested in communication and educational sites.

Boys and girls may be at different developmental levels, though they are the same age. Nielsen (2002) found that boys are significantly more annoyed by onscreen text than are girls (40% of boys complained about wordy websites, whereas 8% of girls did), and girls may request more instruction onscreen. In his website usability study of 55 children, he found that boys spent more time alone on computers, and girls spent more time with a parent.

Wartella et al. (2000) concluded their summary of sex differences with this directive: "Rather than thinking in terms of 'boys' or 'girls', we need to focus on creating interesting content that will engage the minds of *all* children" (p. 30).

Influence of the Internet. Children's use of computers is changing: Computer access is increasing in all groups, even in schools with the highest levels of disadvantage. In a recent study of 512 middle school students, 72% reported having access to a computer outside of school (Miller et al., 2001). For those without this access, the National School Board Foundation's (2000) survey suggests that schools narrow the gap:

in families with annual incomes less than $40,000, 76% of their respondents who report Internet access say they use the Web at school.

Kids are turning to the Internet in their spare time, and they are looking for games. Access to the Internet has seen a tremendous growth in the past couple of years. From 1993 to 1999, the numbers of Americans connecting to the Internet leapt from 3 million to 80 million, (Montgomery, 2000) with 52% of children having access to the Internet in 2000 (Woodard & Gridina, 2000). As access to computers by children outside of school increases, it is important to note that all children, both boys and girls, regard game playing as their most frequent activity when self-reporting their use of computers outside of the classroom (Downes et al., 1996; Harris, 1999; Mumtaz, 2001; Selwyn, 1998; Smith & Keep, 1986).

Montgomery (2000) suggests that new content and services are being created exclusively for children, recognizing that children may well spend a majority of their online time at portals designed specifically for them. Miller et al. (2001) describes the potential of the Internet, including the blending of educational content with game-like features. This trend also includes reaching children in their spare time with educational messages, instead of only through traditional classroom learning times.

Many websites replicate game activities found on CD-ROMS, while also offering puzzles, stories, downloadable art and games, as well as the social communication opportunities. In addition, as Internet access increases, other Internet-based activities may also increase, such as e-mail, instant messaging, and chat. New media abilities of the Internet impact children through interactivity, convergence of existing technologies in

new ways, and ubiquity of the technology in all aspects of children's lives (Montgomery, 2000).

Wang (2002) concluded that little research is openly available on how children interact with Internet resources. Montgomery (2000) suggests that research on children's Internet use exists but that much of it is proprietary and not available to educators. She emphasized that a quality media culture for children must include formal academic research on the benefits and potential harm of new media, as well as development of a "healthy, non-commercial civic sector" (p. 161).

What Guidelines Exist for Game Development?

Game Play

Books, research articles, trade magazines and anecdotal recommendations provide hundreds of suggestions on "how to design for children." The suggestions frequently overlap, but each organizes the recommendations in a different way.

Malone's initial recommendations involving curiosity, fantasy, and challenge are still considered relevant in the field (Dempsey et al., 1993). Researchers suggest that children require graded levels of progressively increasing difficulty, surprises and discovery, and simple input requirements (Smith & Keep, 1986). Based on their usability research at Microsoft, Hanna, Risden, Czerwinski, and Alexander (1999) rephrased some of these suggestions by recommending that activities be inherently interesting, offer expanding complexity and support, and provide supportive reward structures. Rieber, Davis, Matzko, and Grant (2001) identified themes of game play preferences among sixth-grade students. Study participants felt the storyline or context was the most important aspect of

a game, preferred games that offered competition, and felt the social aspects of game play were very important.

As would be expected, graphics, animation, and sound play an important role in children's enjoyment, but the production values of a game do not have to match industry standards. Jakobsdottir and Krey (1993) advocated large, detailed pictures and detailed types of animation. Rieber et al.'s (2001) study participants stated that, though they appreciated high-quality graphics, they are not important factors in critiques. Elliot, Adams, and Bruckman (2002) found that attempting high-end graphics in an educational setting could disappoint students by not meeting industry standards. Stimulating storylines are also key to maintaining interest, and adventure-type stories may be especially appeal to children (Amory et al., 1999).

Following a year and a half of contact and observations with hundreds of children in a variety of environments, Druin et al. (1999) concluded that children want three things from their technology experiences: control of their environment, including how they spend their time with a variety of choices, social experiences in which they can share, show, and use technologies with each other, and expressive tools to tell stories, create games, and build. They also indicate that children are particularly aware of "what is cool," and want to have ease of learning, quality appearance of software and a variety of multi-sensory, multimedia environments.

Interface and Usability

While many of the above recommendations can also be applied to designing the user interface, more specific interface and navigation recommendations include icons that are

visibly meaningful and a cursor design and rollover use that communicates functionality (Hanna et al., 1999).

Most recently, Gulitz and Nielsen (2002) conducted website usability tests with 55 6 to 12 year old children. They concluded that standard usability recommendations are as relevant for kids as they are for adults, including the need for clear, consistent navigation, avoiding non-standard interaction, and avoiding fancy wording. In addition, they found children to be more willing to sweep the screen for hot spots or rollovers (use their mouse to find hidden buttons and links), and are more able to use navigation metaphors like maps or rooms. They found, however, that children rarely scrolled for more information, indicating that all important information needs to be "above the fold" on the screen.

Dempsey et al. (1996) found that adults require clear instructions and well-explained goals and objectives and that discovery learning was frustrating to adults. Reviews of top-selling video games designed for children do not reveal the instructions, goals, and objectives requested by adults. Instead, some games encourage this kind of exploration for children, engaging children in game play immediately without presenting instructions or objectives. Harbeck and Sherman (1999) agree that exploration is attractive to young children (under age 7), and also advocate simple navigation, relevance to real world situations and active, enjoyable experiences. Houser and Deloach (1998) concur and recommend brief initial instructions, with constant feedback alerting the game player to the goal at hand. These prompts include brief, onscreen statements and audio reinforcement of the goal, and an on-screen narrator providing performance coaching at different points of game play.

Rather than suggesting one approach for all children, Kahn's (1999) experience with his program, *ToonTalk,* led him to conclude that children differ in the degree to which they explore, use instructions, or precede game play. He feels that "even the same child will prefer different styles of interaction depending upon her prior experience with the software" (p. 225). He has found success in imbedding puzzles and instructive sequences in larger adventures within *Toon Talk.* In recognizing this diversity among children, Hanna et al. (1999) suggest that instructions be age-appropriate, easy to comprehend and remember, given by on-screen characters that are supportive rather than distracting, and allow children to control access to instructional information.

Learning Theory and Game Design

Bailey (1996) encouraged constructivist approaches with self-directed learning, also advocating that children be encouraged to develop their own games. Overall, she suggested that programs can be enjoyable to children without being competitive, as when framed as a creative activity. Constructivist approaches are also evident in Issing's (1994) recommendations, including learner-oriented study, creative learning in context, active learning, open study, and self-initiated independent future study. Some of the concepts in constructivist approaches echo the previous recommendations of giving user controls over their learning.

Computer-based constructivist approaches should include unpredictability and offer a relaxed set of control for the user, creating a space in which learning can occur. Developing this open framework can be difficult for a game designer (Resnick, Bruckman, & Martin, 1999) and may not be necessary for simple presentation of facts.

Traditional Computer Aided Instruction (CAI) has offered drill and practice, tutorial or problem-solving games. The application of CAI often reflects on Skinner's operant conditioning theory in which a user's voluntary response is strengthened or weakened by consequences that follow (Snowman & Biehler, 2000). While CAI has evolved to include games and simulations that reflect more interactive and constructivist approaches, games that offer simple challenges with rewards and consequences may be easiest to design.

The central theory behind direct instruction is that a teacher must teach properly for a student to learn. Direct instruction includes orientation of what is to be taught, presentation of the material, and practice of what is learned. CAI has taken a direct instruction approach in presenting performance objectives and breaking them into smaller steps (Snowman & Biehler, 2000). Computer games could easily adapt direct instruction by integrating the orientation, presentation and practice into a more engaging game play.

Games may help address some of the limitations of traditional instruction, by encouraging learning outside of classrooms, providing experiential learning through valid simulation, and replacing predictable or static environments (Ruben, 1999). However, Ruben maintains the "ultimate test of the knowledge and skills gained is usually not in the knowing but in the ability to use knowledge and skill sets appropriately — in the translation of knowledge into behavior (p 502).

Thatcher asserted that all game-based learning is experiential learning, and that learning from the experience of game play must include reflection and debriefing. This reflection should include an identification of the impact of the experience, the processes developed in a simulation, a clarification of principles used, the ways in which emotion was used, and views of participants (Thatcher, 1990). Thiagarajan (1996) also

emphasizes the importance of debriefing and reflection in educational games, suggesting that players be given the opportunity to reflect on their feelings of the results, recount their version of the activity, express what they learned, draw a context between the game and the real world, extrapolate from the game to potential situations, and forecast how they would play the game differently.

Users as Designers

Druin (2002) summarized her years of research and experience with children as designers and testers of products by identifying four main roles: user, in which children are observed using technologies, and design is based on these observations; tester, in which children test prototypes; informant, in which children provide input on sketches and prototypes and feedback on existing developments; and designer, in which children are equal stakeholders throughout the entire design process. Each role provides ways for children to inform the design process: developers can decide which role is best based on existing resources, timeframe of the project, and philosophy.

Summary and Implications for Research

The research establishes connections between computer games and play, and also delineates specific recommendations for making computer games fun; such as challenge, fantasy, curiosity, engagement, conflict, control, closure, contrivance and competency base. Research on children's preferences indicate that boys and girls may have specific

differences, and that games can be developed that will appeal to both sexes. The Internet is increasing children's exposure to game play, as well as changing the types of games that engage children, such as the inclusion of social activity within computer game play.

Game development should reflect this research, as well as more specific guidelines related to development. High-end graphics are not necessary, fun and engaging sounds are appreciated by users, and the interface should adhere to basic interface usability guidelines. Children may also appreciate engaging social or creative experiences, and games can encourage self-directed learning through more constructivist approaches. Traditional drill and practice, tutorial or problem solving games can be effective in conveying knowledge or building basic skills. Such learning is more relevant when translated to behavior for the learners, and when reflection and de-briefing is included as part of the game play experience. Finally, utilizing children in the design of the games can give children a voice in development, and designers many options in utilizing their input.

Within the existing research for this field, there is still room for specific examples of preferences among game use by children. Existing research summarizes game play by many children and offers guidelines based on what children as a group tend to prefer. What do these preferences look like for each individual child? How does one child's experience in using a specific game vary from the experience of another child? What can an in-depth review of a specific game offer to complement or contradict existing research?

Additional research can yield specific case studies of game use, allowing developers a special understanding of the interaction between a child and a computer game. Cross

case analysis can then supplement existing research, expanding game play development guidelines for games that are both educational and highly enjoyable for children.

CHAPTER 3

METHODOLOGY

Overall Approach and Rationale

This research includes analysis and case studies of 5 children using *The Food Detectives Fight BAC!*® website. Participants were observed at home or at a school setting during their free time on computers they frequently used. The session lasted 1 to 2 hours and included an opening interview, a verbal pre-test, observation and discussion while using the website, follow-up interview and verbal post-test. Some participants also chose to share their favorite online games or websites during the session.

My interests in children's experiences in using the site in their free time and on computers regularly used meet several characteristics Marshall and Rossman (1999) outlined as being strengthened through qualitative methodology:

1. I am interested in the processes children use to navigate the site, learn about the games and interact with the software. This figures prominently in cross case analysis.
2. This kind of context-sensitive use is difficult to replicate in a lab or experimental setting.
3. Relevant variables had yet to be identified regarding children's use of this site. In addition, variables that have been identified by Malone and others regarding game play may be updated. These variables are also conveyed through cross-case analysis.

Case studies are an effective strategy for focusing on society and culture, immersing the user in the setting (Marshall & Rossman, 1999). While the nature of this research does not seek to identify a larger culture, or even a gaming culture, it immerses users in the setting of a game, revealing their behaviors, thoughts, and attitudes relative to that setting.

A qualitative examination of kids using the site unveiled their preferences, attitudes, and opinions regarding the site's entertainment and educational value. Interview transcripts and observation notes were used to generate case studies and identify themes. The case studies speak to the diversity in entertainment and educational value the site had for each participant, and highlight specific use examples. Verbal pre- and post-test analysis documented learning that occurred regarding food safety. Cross case analysis revealed differences in how each user used games within the website and generated themes among users regarding game play experiences. These themes highlight similarities in enjoyable aspects, and a diversity in what entertainment values are important to users. In some cases, follow-up contact with participants' parents provided additional information confirming conclusions that were drawn. Selected peers reviewed all data to identify bias, identify leading questions, and question unclear findings. In addition, another peer reviewer analyzed original data and resulting case studies, confirming that valid conclusions were drawn.

Sampling

Participants were solicited two ways. An email was sent to a local technology community listserv seeking children with high-speed Internet access, and five parents volunteered their children (all girls). The interview of one of these 5 was lost due to technical difficulties, another was disregarded in favor of finding boys for the study. Two boys were recommended by a colleague who knew the boys' mothers. The final sample included 5 participants, ages 8 to 11, in third through fifth grades.

Participants were interviewed at a computer they were familiar with — 3 at home and 2 at after-school computers — so that interaction with the hardware, software, connection settings and other computer-based aspects were familiar. All computers had a fast Internet connection — key in utilizing all of the website within one 2-hour sitting.

Selected participants were asked to use the *Food Detectives Fight BAC!*® website. I recruited the participants and asked them to engage in the specific behavior of observing the site, in contrast to observing naturally occurring behavior among those predisposed to seek out and use the site. In asking participants to review a specific site, participants may have identified me directly with the site and wanted to please me with their comments. Some parents revealed that children shared their experiences with them after the sessions, telling them they wanted to "be nice" during our session and offer kind versions of their true feelings. Peer reviewers attempted to note cases in transcripts where participants may have been trying to please me with their answers rather than offer their true feelings. In some cases, I observed a child *saying* an activity was "okay," when the child appeared unengaged or bored: these instances are noted in my observation notes. Finally, in asking

participants to use a site, I may have observed site use that would not have otherwise occurred. If a child finding the site on her own was unengaged in the first 5 to 15 seconds, she may have simply abandoned the site. Because I asked participants to review the site, I observed them playing several activities within the site, even though they may not have chosen to do so on their own. I attempted to reveal such instances by telling each participant they could quit at any time and by asking participants regularly, "What would you do if I weren't here?"

Originally, I proposed tracking the length of time each participant was engaged in each website game and including this in the final analysis. However, I chose not to include this information, as it conveyed an inaccurate representation of the participant's engagement. For example, in some interviews, discussion about the game took place during game play, extending the period of time spent by that participant on the game. In another, one participant spent a longer period of time on one activity because he was a slow, methodical reader — not because he was engaged. Another participant took her role of "critic" fairly seriously and chose to spend time reviewing each song for the duration, when she implied she would not normally have listened to each song all the way through. Because engagement or lack of engagement are well documented in the case studies and cross case analysis, I chose not to include particularly misleading information regarding time spent on each game.

Data Collection and Analysis

Each data collection session (one per participant) began with a review of the consent form, including instructions that the participant could quit at any time. Each participant was then interviewed regarding their computer and gaming experience, food preparation behaviors and gaming preferences and given a verbal pre-test on food safety knowledge (included in Appendix B). The participant was asked to use the site while using the talk aloud method — verbally describing their thoughts and explaining their choices while making decisions — and encouraged to behave as if I were not there. Following use of the website, some participants demonstrated their own favorite online games. Follow-up interviews included discussion of the *Food Detectives* website and other online games. Finally, each participant was given a verbal post-test, included in Appendix A.

Interview, Observation and Follow-Up

Seidman (1991) stated that the purpose of in-depth interviewing is to understand the experiences of others and give the experiences meaning in a larger context. He suggested a three-interview structure for in-depth phenomenological interviews, beginning with a focused life history, followed by a second interview focused on the details of the experience, and concluding with an opportunity for reflection by the participant on the meaning of the experience. I did not conduct a true phenomenology of a culture, rather a look at individuals with a similar experience – the use of the website. I adapted this three-point plan to include:

1. Focused use of *The Food Detectives Fight BAC!*® website, with participants using the Think-Aloud Method (van Someren, Barnard, & Sandberg, 1994).
2. Interviews and discussion detailing the experience and targeting knowledge gain.
3. Reflective interviews encouraging participants to related the website to other favorite games and their entertainment components.

While Seidman stressed the importance of multiple extended interviews, in a pilot study refining my methodology, I conducted preliminary interviews with participants and concluded differently. These interviews indicated that one interview was adequate with this age group, and a two hour session allowed adequate time for site exploration, interviews, discussion, and pre- and post-tests.

At the beginning of each session, I introduced myself and worked to build a rapport with the child. I explained the think-aloud process, giving an example of how it could work. The pilot study indicated that some children were comfortable with this, while others were not as talkative. As expected, I supplemented the talk-aloud process with prompts and questions regarding the site.

Questions asked included variations of the following:

- Describe the perfect computer game: how would it look and sound, and what kinds of activities would you do?
- What did you think of the website? Of each game?
- How could the site have been improved? What should be changed? What should be left alone?
- If you had 2 free hours today, how would you spend that time?
- What makes this game fun? Or, Why wasn't this game fun for you?

- Do you think you learned anything from playing this game?
- Would you describe this website as a games site or as an educational site?

The opening interview and verbal pre-test were conducted while seated, with the participant and I facing each other. I did not take notes during this process. While the participants used the website, I sat slightly behind and to the side, so that I could see their reactions, see what they were looking at onscreen, and allow them to feel that I was out of the way. During the follow-up interview and post-test, I took occasional notes when the participant would return to the screen to make a point or provide an example. I later reviewed transcripts of the entire session to develop a master evaluation document for each participant. This master evaluation document included my methodology logs immediately preceding and following each session; my observation comments relating to the participants' actions, and non-verbal communication; transcripts of our interview and discussion; follow-up communication with parents; pre- and post-tests documenting incorrect answers: and evidence of knowledge gain. A sample master evaluation document is provided in Appendix B.

In analyzing hundreds of children using technology, Druin et al. (1999) suggested conducting field research in which the participant regularly uses the computer with one interactor and two note-takers. They found children were distracted when the interactor took notes. One of the two assigned note-takers recorded activities, and the other recorded quotes. I agree with Druin et al. that it may be possible to miss important data when serving as an interactor, and I recorded the audio of the proceedings to supplement my notes. However, in both my pilot study and this study, I found the children were not distracted by my note taking while they were using the computer; in contrast, it may have

decreased the feeling that they were being observed. In several cases, I typed intently without necessarily documenting anything, just to aid the participants in feeling that they were free to take their time in navigating the site and that I was in some way engaged, not watching their every move.

In my observation notes, I addressed participants' apparent interest in each game or activity and their familiarity with the interface and game play. In many cases, these observations prompted questions in follow-up interviews.

Immediately before each session, I used a methodology log to document concerns and interests regarding what was known or expected about the session, such as the participant's familiarity with computer games or a parent's technical skill. I also included expectations I had for each interview, based on previous interviews with other participants. Following each session, I commented on the experience, personality of the participant, the use environment, and other details I felt would be essential in developing a sound case study.

Following the session, after the case study was generated, peers reviewed transcripts identifying bias and, in some cases, suggesting additional questions regarding each participant. I contacted a parent of each participant with follow-up questions regarding the participant's reading skill and the participant's expressed opinions about the game or website and asked if there was other information the parent had that could help me in my study. Only one parent did not respond to follow-up questions, despite multiple calls.

Pre- and Post-Test

To aid in determining knowledge gain, a verbal test was given to each participant before and after using the website. Issuing the questions verbally prevented variance due to differences in reading or writing skills among participants. Additionally, it contributed to a more social aspect of the interview, rather than a school-like testing environment. Finally, verbal testing allowed for prompts or clarification based on the participant's response. The test included some multiple choice (which were adapted for participants who answered "in between" the response options) and some open-ended questions.

Quantifying food safety knowledge can be difficult; for example, the National Fight BAC Partnership recommends that hands be washed for at least 20 seconds — should an answer of 30 seconds be marked incorrect? The test questions are listed in Table 1, with notes used on assessing the answers.

Table 1
Pre- and Post- Test Questions and Assessment Notes

Test	Assessment Notes
Washing Your Hands Sometimes it is important to wash your hands. Other times you can wash your hands, *but it's really not needed*. Mark the times when it is important to wash your hands. **Before** going to the bathroom **After** going to the bathroom **Before** watching television **After** watching television **Before** making a snack or drink **After** making a snack or drink **Before** playing with a dog or pet **After** playing with a dog or pet **Before** doing your homework **After** doing your homework **Before** feeding your baby sister **After** feeding your baby sister **Before** playing basketball outside **After** playing basketball outside	Because it is never "wrong" to wash your hands, participants were expected to mark at least those areas where it was *required*. A wrong answer would include *not understanding handwashing is important* for one of the following: **After** going to the bathroom **Before** making a snack or drink **After** playing with a dog or pet **Before** feeding your baby sister **After** playing basketball outside If a participant answered that it was important to wash hands for any of the other instances, this was not marked incorrect. For example, some participants felt feeding a baby sister would get baby food all over their hands, requiring hand washing. While it is not considered required, they were not faulted for this answer. Participants were not faulted for washing hands when it wasn't required.
How long should you wash your hands for? · At least **5 seconds** · At least **10 seconds** · At least **20 seconds** · At least **1 minute** · Only as long as it takes to **get them to be completely wet**.	Hand washing with soap and water should take **20 seconds.** Individuals who believe it should take at least one minute may miss important handwashing opportunities by believing handwashing takes too long, choosing to skip it completely rather than invest the time. **Any answer other than "at least 20 seconds" is considered wrong.**
Putting Leftovers Away You've eaten a pizza with your family, and there are leftovers. If you want those leftovers to be safe to eat the next day, **how long can they be left out** before refrigerating them? · No longer than **30 minutes** · No longer than **1 hour** · No longer than **2 hours** · No longer than **4 hours**	Leftovers should be left out no longer than **2 hours.** While it is not harmful to refrigerate leftovers sooner than that, a participant who believes 30 minutes or 1 hour is the maximum length may waste food by throwing it away. **Any answer other than "No longer than 2 hours" is wrong.**
Killing Bacteria Bacteria lives on food we eat, and sometimes on our hands or other things. **List 2 ways you can kill bacteria.**	There are several ways to kill bacteria, including medication or sterilization. The website encourages two methods: washing (hands and utensils) and cooking to the proper temperature. In instances where participants gave two answers that could be correct, but did not include washing and cooking (such as medication), they were encouraged to name *any other* ways they knew of. ***Correct* responses included both washing and cooking.**
Chilling Food Why keep food cold in the fridge or freezer? What does it do to bacteria?	**A *Correct* response would include acknowledgment of slowing or stopping bacterial growth.** Refrigeration and freezing does not kill bacteria, it only slows the growth.

A pre- and post-test document was made for each participant, documenting all answers to the questions, including additional comments made by participants. These were then analyzed by denoting incorrect responses in both the pre- and post-test, and highlighting sections in which learning had occurred. This learning was noted in each case study and in some cross case analysis.

Because the nature of the pre- and post-test analysis was qualitative, testing effect was not measured: the pre-test may have alerted a participant to an answer during website use, thus increasing the likelihood of that participant answering it correctly on the post-test. For this reason, when I noticed participants answering a question differently on the post-test, I asked them to tell me how they knew the answer. Based on their responses, I made a decision on their learning of the content.

Analysis

A master evaluation document was created for each participant by combining transcripts with observation notes, pre-session and post-session observations, pre- and post-test results and, in some cases, feedback from parents. The final analysis document reflected the vocabulary and reflections of both the participant and myself as the observer, as well as a parent. In preparing this document for analysis, I summarized each section, breaking the document into content discussed and games played. A sample master document is included as Appendix B.

Each master document was reviewed by two peer reviewers. The first reviewer identified leading questions, instances of multiple or confusing questions, and possible bias in my interpretation of each participant's actions and summary of each section. The

second reviewer analyzed the master document and resulting case studies, confirming conclusions or indicating unfair or inappropriate generalizations. Case studies were revised to resolve all issues identified. In writing case studies, I reviewed the master evaluation document and the audiotape of each participant, crafting a rich, thick description of key features for each participant. Each participant's case study reflects individual computer experience, activities visited on the site, specific instances of the site experience and enjoyment level, and distinguishing characteristics of that participant.

I relied on organization of the data through nVivo, a qualitative analysis software tool. I conducted cross case analysis by reviewing each participant's use of each activity, identifying similarities or differences in how each participant played the same game. I generated conclusions based on these themes. Second, I reviewed categories across participants on enjoyment preferences for both the *Food Detectives* website and other games. These categories changed repeatedly as I reorganized sub-categories into larger categories. I used a variable-oriented analysis, seeking themes across cases, and specific instances within each theme. This process is detailed in Chapter 5, *Cross Case Analysis*.

Trustworthiness, Personal Bias, and Ethical Considerations

In adapting work from Rossman and Rallis, Marshall and Rossman (1999) emphasized the researcher's responsibility to scrutinize his or her own biography, power and interaction with participants and writing, as well as being vigilant about ethics. All methods of collection and analysis in this study have been detailed to allow readers of the final research document to assess my trustworthiness. Data was summarized in case study

format for each user, allowing the reader to understand the personal thoughts and stories with each. In addition, data was summarized in tables to clarify common themes and variables, allowing reviews of my interpretations by others during the coding process. Peer reviewers have identified interpretive bias and leading questions, and these have been noted in the master evaluation documents available in Appendix B, as well as noted when appropriate in Chapters 4 and 5. Finally, a modified member-check occurred by verifying some interpreted data with parents of participants.

I understand my ethical responsibilities to the participants. I have made every effort to fully educate them regarding the study and their potential risks and reward for being involved and received their consent based on required university Institutional Review Board specifications. Each participant's parent was included in the decision to participate or not participate in the study, and I emphasized that participants could withdraw at any time from the study. In describing each case, a pseudonym has been used, guaranteeing anonymity to participants. Although I offered to grant requests of participants or their parents to provide copies of their interview, destroy interview tapes, or offer final copies of the report, no request was made.

I understand I have a responsibility to follow through on this research, providing value to the field in exchange for participants' time and involvement in the project.

CHAPTER 4

RESULTS — CASE STUDIES

Julia, David, Maddie, Joshua, and Grace had a lot to say about the *Food Detectives* Website and about games, in general. Of course, some of their most important revelations came through not what they *said*, but in what they *did*. Each of them allowed me to interview and observe them while they used the Food Detectives Website, and in some cases, other websites. We discussed the website, their computer and gaming experience, their views on games, in general, and their food safety knowledge. In addition, each answered questions on a pre- and post-test regarding food safety. I had follow-up conversations or emails with a parent of four of the participants. Appendix B includes a sample annotated document for one participant, which includes the transcript of the interview, observation notes, results of pre- and post-tests, and correspondence with parents. These documents were used in developing a case study for each person, and in cross case analysis.

To best understand the experiences of the 5 children, results of this research have been organized into three sections: case studies profiling each user and a reference table listing key observations of each participant, cross case analysis of the use of each section of the Food Detectives Website, and cross case analysis of gaming preference themes that emerged in the data.

Case Studies

Julia: Rushed Enthusiasm

Julia's father comes out in the rain to my car to meet me, I knew him previously through classes, but had never met his daughter. Julia is waiting at the door and leads me directly to the computer room so that we can get started right away. She has the maturity and comfort level around adults often found in an only child, talking easily with me, informing her father that she can "take it from here." In our first 5 minutes of conversation, as I am getting my bag unpacked and taking my coat off, she shares with me her age, (9 and three-quarters), her passion for Harry Potter (her aunt had just sent her Harry Potter pencils, posters, and pencil case written in Italian), and information about her dogs. Earlier, her father told me that Julia was just starting fourth grade, her first year in public school having been home-schooled so far.

Though my interest is really more about her experience in playing the games than in measuring knowledge gain, I wanted to understand how much she already knew about food safety and what information would be new to her. In giving a pre-test verbally, I hoped to make it feel less like a test and more like a conversation. Julia has no problem answering the questions, in fact — it takes about 20 minutes to review the 11 simple questions, as she frequently interrupts to share stories and offer additional information. As Julia jumps from one story about stirring brownies with her mom to another about the time her friend was hit on the head during an impromptu violin concert, I begin to understand that this young lady thinks fast, speaks fast, and moves quickly. At one point, she even interrupts herself, asking if I am ready to begin working on the computer, as if I

have been holding her back to this point. She demonstrates a familiarity with the importance of hand washing, though she overestimates time required to do so properly. Similarly, she assumes leftovers can only be left out 30 minutes to be safe, rather than the 2 hours recommended. She understands that washing hands kills bacteria, but is unable to name another way, such as cooking, that kills it. I make a note of this: I want to pay particular attention to the randomized informational blurbs she receives, or the parts of the game she visits to see if she is exposed to the information that will correct these three gaps in her knowledge.

She asserts herself in front of the computer and takes control of the mouse and keyboard. I spell out the URL for the website, and watch as she moves easily to type it in to the web browser. She tells me that she plays games quite a bit, is allowed to do so alone in the office, and enthusiastically starts sharing aspects of her favorite games with me, including one of the websites:

JULIA: Well, you see, you get to crawl under wire on mud, and chin-up on bars, and dodge barbed wires and walking. And if you by accident step on a tick, you go like this: boing, boing, boing. And you still have to go all the way back.

Q: Cool. So if you're going to describe this to your friend, you're going to tell them about the obstacle course, and they've seen it, you say, "Well you know what I really love about the obstacle course? What's so much fun about it is… what would you say?

JULIA: It's challenging.

Q: Oh, it's challenging. How is it challenging?

JULIA: Well, if like if you hit the barbed wire like you get stuck there. And you get stuck in it. And if you fall, and you can walk through water and there's these things, like hats, if you pick it up you get points. And, if you pick up this blanket and you fill the whole blanket up you get like a hundred points.

Even while typing on the keyboard and moving through the website, she chats with me easily about the other games she plays. She is very verbal, expressing the sounds, describing how she laughs at funny places. She suggests showing me her favorite sites… I recommend we do it at the end of our session.

Julia begins using the website, moving very quickly over the opening site, and directly into the opening trailer. When the trailer mentions vomiting and diarrhea, Julia wrinkles her nose. “That’s kind of gross,” she says, “Didn’t need to hear that. What was that? Was that diarrhea? How come?” I am surprised, the sound of a flushing toilet and mention of body fluids always elicits a giggle in other kids I have observed. It is as if she is amazed that a game for children could be so juvenile.

I ask her about the trailer, “If I weren’t here, and you were playing and saw this, would you say, ‘Forget it, I am not playing anymore?’” She responds: “I’d probably say, oh… why’d they put that in there? That’s gross. Then I’d play it again and skip the intro.” I am impressed by the fact that, despite our chatting while she navigates the site, she noticed the small, light “skip intro” button in the lower right corner of the screen. She does not seem to miss a beat.

She tells me that she likes the Food Detectives characters and the graphics, but cannot express what is “cool” about them. She selects “The Case of the Food Gone Bad.” I notice that she whips through the opening text instructions for this concentration-like matching game, just as she sped through the opening instructions for the website. I wonder if she is reading and absorbing the information or simply skimming the text. As she begins matching cards the informational blurbs appear. She pauses only a few seconds and then clicks “OK,” dismissing the information. I assume she is not reading the

text in such a short period of time. Another match: this time the informational blurb is a joke. She laughs outloud, repeating the punch line, “He had to stop, he ran out of juice!” and giggling. She reads the text on one of the information screens about the 2 hour rule. I make a note to see if she is now able to answer that question correctly on the post-test. She returns to the frantic process of matching cards, yet does not finish clearing the board. She exits.

Q: What made you decide to try another one?

JULIA: Well, I’m curious about what they look like. What the other cases are.

Q: So what’d you think of that case?

JULIA: I think it was cool. It’s like a memory game.

Q: Do you think you learned anything?

JULIA: Yeah, I learned stuff.

Q: What do you think you learned?

JULIA: I learned how to keep bacteria and junk out. I can’t quite explain it.

I do not grill her on this point. It is clear to me she does not want to discuss it. She wants to hurry up and play another game.

She moves to the Case of the Kid Who Knew Enough and, again, rushes through the printed instructions. Despite this, she had no problem moving through the interface to make the stickers. She moves around the screen easily and silently begins quickly filling each of the four stickers with backgrounds, borders and characters.

Q: So tell me outloud, what’re you thinking so far?

JULIA: Well, I’m thinking this is pretty cool.

Q: The stickers?

JULIA: Yeah.

Q: What's neat about it? What do you like so much?

JULIA: Well, I mean, look at this, you're making your own stickers. You can make, put what you want to put on. It's very cool.

Q: You like being able to create that?

JULIA: Yeah, I like being able to create a case. What piece to use? Hmm, it's the bridge. This is so cool. Ooh.

Q: What do you think about the graphics?

JULIA: I think they're pretty cool.

Q: Sometimes with the graphics is it because of the colors or do you like what the pictures are?

JULIA: I like what the pictures are and I like the colors also.

As she is talking, her voice trails off and she devotes more attention to the screen. She is clearly delighted by this game and enjoys the activity. She decides not to take the time to print, though I do not think it is because she is disinterested. Rather, I do not think she wants to lose time to the printing process. She exits, moving towards the handwashing timeline, the Case of the Filthy Fingers.

I fully expect her to zip through the instructions to this game, and she does. She makes only one error in deciding when to wash hands, indicating it is important to wash hands before going to the bathroom. She does not click the plunger at the bottom of the screen for a few seconds and wonders what to do. Once she notices it, and sees that she has one wrong, she talks outloud about where she thinks she messed up, but runs out of time before she has a chance to make the change. She chooses not to play the game again.

As Julia moves to the shooting/arcade game, the Case of the BAC That Kept Growing, I understand she may not be zipping through the instructions, but reading them

very quickly. As she begins the shooting game, she is the first user I have seen immediately use an ice cube to “freeze” the BAC and make them easier to shoot. Most other players shoot quite a bit, developing their strategy until they notice the ice cube and experiment with it. I ask her why she used the ice (“To get more hits,” she tells me, as if it should have been obvious to me!) and how she learned to do it. (“It said so in the instructions,” again, with some impatience). She plays this game for a few rounds, progressing each time. When she misses enough to face the “game over” screen, she exits. She is able to explain the difference between the flame shooter and the soap shooter, and says she likes the game.

She moves to the BAC TV interface and progresses through each song, left to right on the screen. At first, she says the song is boring but sits patiently with her hand off the mouse as the song plays. I assume she notices the “exit” button — just as with the “skip intro” button on the trailer, but she lets the first song play out completely. As she moves through the songs, she dances a bit in her chair and taps her toes to the music, though she is not smiling. After playing all of the songs, each all the way through. I ask her about them.

JULIA: I really like them. I like the songs.

Q: You like the songs?

JULIA: Yeah.

Q: Do you like watching the movies?

JULIA: Yeah. (song in background). This song sounds spooky.

Q: Oh, do you like the spooky sound of it?

JULIA: Yeah.

Q: What do you think about the songs? How would you describe them to somebody?

JULIA: I'd say the songs are really cool.

Q: How about the person singing it?

JULIA: I think it's really good, it's a really good voice.

Q: What do you think about the animation? How this looks on the screen?

JULIA: Huh? Oh, that's really good.

And then later,

Q: So, if you were telling Sara, if she asked what you were doing today, and you told her you were looking at this site, how would you describe these songs to her?

JULIA: I'd say the songs are really cool. It really inspires to take more care, better care of yourself. Take care of your food.

Q: Oh yeah? What'd you learn about all that? You said it inspires you to take better care of yourself and your food. How would you do that?

JULIA: Cook the food, wash your hands, chill it, just take good care of yourself.

As verbal as she is, I am surprised that she is unable to explain why she likes something, just that "she does." She then goes back to each case and plays each game again. She clears the board in a concentration game this time. Again, she misses one on the handwashing timeline and suggests that the game give her some hints to help her. She spends a great deal of time playing the shooting game, moving to level 11.

As I move to follow-up questions, Julia again confirms that she likes the site, offering specifics about the shooting game:

Q: Now, if I told you okay, "Julia, we're going to give this game a whole overhaul. We're going to change it." And you're going to tell me, "okay, Barb, that's fine but whatever you do, don't change…"

JULIA: Don't change that shooting thing, or the background! The backgrounds are good.

Q: Oh, you like the backgrounds.

JULIA: Yeah. Especially the picnic one.

Q: Oh, you like the picnic one?

JULIA: Cause I'm hungry, it's already my snack time.

And about the matching game:

Q: Tell me about the other game that you saw. How could we make the card, the matching game, how could we make that better?

JULIA: Well, you could make it a little harder. Like put, four of each kind in there, so they'd challenge a little bit more. Or one with bacteria card, if you got that the game was completely over.

Q: Ooo, kind of like a hidden thing?

JULIA: Yeah.

Q: okay, how about the filthy fingers, handwashing game?

JULIA: That's the difficult one, leave it the way it is.

Q: Now you said you liked being challenged in some of the games, but that one seems the hardest, but you don't want to go back and play that one. Is that right?

JULIA: Yeah.

Q: How come?

JULIA: I just, don't know. I can never get it right. I always get one wrong.

We review the post-test questions. This time, she answers every question correctly. I ask her how she knew she needed to wash her hands for 20 seconds, and she tells me it was in a song. Similarly, when she answers that 2 hours was acceptable for leftovers, she tells me she learned it in a song. Regarding cooking the meat, again, she tells me she learned it in a song. While I know all of this information is in the songs she heard, I

wonder if it was the combination of the cases and the songs, and the songs were easier for her to recall.

Our time is running out, and I let her know that I am done with my questions. We talk more about Harry Potter, and she decides to share some of her favorite games with me. I watch as she plays some, and shows me what she can do. I feel as if I am her Aunt, and she wants me to be proud of her game playing activities, just as if she would have asked if I wanted to see her room or her favorite toy. As I left, she went to her room to get a drawing she had made for me. I thank her and she gives me a hug as I leave. I wonder if her affection for me created a desire to please, influencing her game playing behavior. Was the second round of game playing for my benefit? Would she *really* recommend this site to others, or did she feel that I wanted her to like it? Was she *really* engaged the whole time, or did she want me to stay with her – serving as an audience?

As I am leaving, I ask her father about her reading level: it is exceptionally high. She had already completed reading the *Hobbit* and was beginning *Lord of the Rings*. Though Julia moved with an anxious speed throughout all of the on-screen text, her understanding of the games suggested that she actually read it.

A few days later, I receive an email from her father:

> Just wanted to let you know that Julia went to the Food Detective site on her own last night and was there so long I had to drag her off the computer to go to bed! She was singing along with the songs and had to print out the stickers she created. She really likes solving the cases.

This unsolicited information speaks to Julia's interest in the site: it most likely held her attention for the duration of our 2-hour session, and was attractive as a repeat site — tremendous praise from this fast-thinking participant.

David: Simulation Gamer

Shortly after my session with David, I referred to him as "the kid who would rather hop on one foot in a circle than play games on this website" — of course, that may not have been entirely fair. After all, David is engaged through his first three games, and only lost interest after feeling frustrated by the handwashing timeline and listening to the songs, eventually killing time by hopping on one foot in a circle while he waited for his mother to finish her work at the school where we met. David loves simulation games and — even though he enjoyed the sticker making game, the matching game and the BAC shooting game — was full of ideas on how to make the Food Detectives Website better — mostly by making it more like a simulation game. When we started our session, I had no indication he would eventually become disinterested with the site — let me start there.

David's mother is a teacher at an elementary school where a group of kids has gathered to discuss this website with some instructional designers. Most of the kids in that group were over 12 years old, above the target age range for the program, but David, 8 years old and in the third grade, had tagged along with his older brother. While the older kids adjourn to the computer lab to review the site, David and I slip into the side office so he can use the site alone.

David is extremely likeable. Though school has just let out and he looks a little tired from the wear of the day, he is talkative and his eyes are bright. As we discuss his computer experience, he enthusiastically shares his favorite games and tells me about the challenge and play experiences involved. After the session, a colleague who knows David and his family tells me he is very computer savvy, playing games on a daily basis with

his father. Additionally, he is not allowed outside during the day, due to his fair skin and fears of skin cancer, so he spends a great deal of time on the computer.

As David and I review the pre-test questions, it becomes clear that handwashing has been discussed in his home. David knows most cases of when to wash hands, though he does not feel it is important to wash hands before feeding a baby sister or after playing basketball outside. He overestimates the time handwashing should take: he understands hands should be "completely clean, soap all over, in between," but feels that should last at least a minute, rather than just 20 seconds. Similarly, he errs on the side of caution by saying leftovers should be left out no more than 30 minutes to be safe. David understands that bacteria can be killed by washing hands, and believes that freezing or chilling bacteria kills it.

He watches the opening trailer with little enthusiasm and patiently works through the text on the opening screen. He seems content to take his time to read all the text thoroughly, I wonder if this stems from his experience with simulation games where time must be spent reading and working through various options. He selects the Case of the Food Gone Bad, the card matching game, because the case folder is green – his favorite color. He makes a match and receives the first informational blurb, clicking "OK" without reading the text. His next match reveals a joke… just as he is about to click "OK," he pauses and reads the text. I hear him laugh at the joke, then he reads it outloud to me, so that I can get it. He gets two more jokes in a row, sharing the punch lines with me. After that, he takes the time to read each informational blurb outloud to himself. I notice his reading takes time, and he stumbles on several words. I suspect his reading level is similar to most other third graders.

David moves on to the BAC shooting game, reading the directions thoroughly, even using an ice cube in the first round to "freeze" his bacteria. He plays well and understands the difference in the flame and the soap bubbles, developing a strategy to kill more BAC. While he intently plays, offering several yells of "Yay!" when finishing a round, he is clearly enjoying himself. He plays a couple of times, and when finished, exclaims, "Now THAT was fun!"

David next creates stickers and does something I have not seen any other kid do with the program. As he reads the directions and moves through the program easily, he decorates only one of the four stickers. As he prints this sticker, he tells me he has left the other three blank, so that he can draw them in at home. I am impressed with this "outside the box" thinking.

David progresses to the handwashing game. He reads the directions, but seems to have problems following the timeline, missing handwashing scenarios he answered correctly on the pre-test. For example, he knew to wash hands after going to the bathroom, but missed this in the game, signaling confusion with the timeline concept. In the game, the timeline moves from the left of the screen to the right, then down and to the left again. After this "bend in the road," David gets confused, thinking he is saying he washed his hands *after* going to the bathroom, when he really says to wash his hands *before*. He waits as he finishes, neglecting to hit the plunger or change his answers. He exits without playing again.

DAVID: That was sorta fun.

Q: What did you like about it?

DAVID: It was just a little fun.

Q: Not real fun but …

Q: What made it not fun?

DAVID: It's just not my kind of game I like to play.

Q: okay.

DAVID: I like multiple choice games but just not that one.

On reflection, I wonder if this unsatisfying handwashing activity prompts his disinterest in the rest of the site.

David moves on to the songs with waning attention span. He slowly rolls his mouse over the buttons, accidentally discovering the song titles at the bottom. He selects one song and listens to it all the way through, then the next, then a third. Halfway through each song, he seems to have had enough, but does not exit. After the third song, he lets me know he is done with the site.

We progress with the post-test, and David now answers the leftovers question correctly, responding that the 2-hour rule information was in the game. As I ask him about his opinion of the site, he volunteers the following:

DAVID: So far I think this website would be for maybe first grade. First and kindergarten, because we have kindergarten buddies this year and they put their fingers in their mouths a lot.

At the beginning of our session, David overheard the instructions given to the older kids evaluating the game. They were asked to decide what audience this game would be good for. I suspect David is remembering this as he volunteers this information. He feels the site is for younger kids, not necessarily because of the game play, but because of the belief that kindergarteners have more to learn about the topic.

As we conclude our session, I invite him to have some grapes and cookies while waiting for his older brother to finish. He disappears for a while, then comes in and looks

for a cookie with chocolate chips. In talking with his mother, I notice David out in the library, contently hopping on one foot in a circle. I wonder if he will return to the site later that afternoon, but doubt it given his interest in the hopping. He mentioned several times that the site was "Good" or "Okay," though I wonder if this is to keep from disappointing me. I can never really know if any of the kids are being completely honest in their assessment of the site and pay attention to their behavior. Regardless of David's comments, he was engaged – seemingly pleasantly so – while playing a few of the games. During the jokes in the matching game, he laughed and wanted to share the experience with me. During the shooting game, he was full of "ooh's" and "Yay's" while shooting, obviously giving full attention to the experience.

David's dad is interested in game play, and his father often plays games with him. Given this, I imagine David would have played these games on his own if his father had suggested them. He might even have played 30-45 minutes if he had stumbled upon them on his own, though I am fairly sure he would not return to the site after initial use. As I am packing up my things, his mom comes out to solve the mystery of David's pre-snack disappearance — he had been washing his hands.

Maddie: Game Play as Social Experience

I think it may actually be impossible to gather up a group of girls, all under age 10, without some amount of giggling and laughter ensuing. This was certainly the case when I observed Maddie, her friend, and younger sister reviewing the website. When I arrived at Maddie's house, I found her 9-year-old friend, Linda (who was in the next grade up from Maddie — fourth) was there, as she usually was after school. Also, Maddie's 6-year

old sister, Rena, was in the room. Maddie's mom told me that Maddie was ready to use the site, and the other girls would just hang out in the back of the room and watch. I knew the likelihood of two young girls quietly watching was low, but I wanted to get Maddie in her natural game-playing environment. As her sister and friend were frequently with her when she played games, usually after school, I decided this interaction was an authentic example of how the website would be used.

When I first arrive at the door, I am overwhelmed by Maddie, Rena, Linda, Maddie's younger brother, and Buddie the family dog. Somewhere in the back of this crowd is Maddie's mom, who welcomes me in and points me in the direction of the basement, where the computer is located. Maddie immediately takes my hand and walks me down to the basement, sitting at "her computer" (her dad's computer is on the desk next to hers) wanting to get started right away.

She is very talkative, and very easy to listen to. I enjoy hearing about her kitchen experiences where she baked cookies with her Buppie (grandmother), and about the games she likes to play. She has just finished visiting a site that is new to her and shares how she could build rockets on the Jimmy Neutron site, racing them in different environments. "And sometimes," Maddie says, "you could do it in Jimmy Neutron's dad's brain. Now that…that almost made me throw up! I tell you!"

Maddie acknowledges that she is pretty good at computer games, I certainly believe she has a familiarity with them, and a strong sense of game play. She has an ability to give specifics about what she likes in games; such as the type of game play, the noises, and even the kinds of graphics. I ask her to imagine she has just been to the "perfect web

site" and to describe it to me. Rather than just giving me one example, she crafts an example from several sites she has been to:

> MADDIE: It taught you how to learn and it would have some coloring pages that you can color. And sometimes you can build things like rockets. And they had books that you could click on and decide which one you want to read. And sometimes you can read to them yourself and you could click on a little smiley face. You can click on it and it can tell you the story by itself.
>
> Q: Okay. What would it look like? This fun game that you play with?
>
> MADDIE: Well, it might be, it might have a background of a school. And there would be an easel that you could click on, and a book shelf.
>
> Q: Would they be bright colors? How would you describe them? Would they be photos?
>
> MADDIE: Well, there might be some comics, and regular books. And there might be also a little place where you… where your… where there's a little piece of paper that tells you how good you are at this computer game.

Her ideals seem to follow a few themes: offer activities where the user can be creative, offer variety, and include feedback. As we move into the oral pre-test, Maddie admits that when it comes to hand washing, "Sometimes it's hard for me to remember," indicating that handwashing has certainly been discussed at her house. She is able to note most of the instances when it is really important to wash hands, but focuses on when hands "look" dirty. For example, she feels she should wash hands after feeding a baby because they would be dirty, but it was not necessary before. She is incorrect in how long she should wash hands for — thinking 7 seconds would do it — and believes leftovers could be left out for 4 hours and still be safe. She knows washing hands and taking baths kill germs, but not cooking. She also understands that putting food in the refrigerator will keep mold off, and keep germs off of food.

We begin to use the website and I help Maddie with the URL. She is a slow typist as she hunts and pecks to find the letters on the keyboard, but has computer literacy. She is able to launch a web browser and has a comfort with the mouse. The trailer begins and all three girls are immediately quiet as it starts, but burst into fits of giggles with the toilet flush sound and the word "diarrhea!" Maddie clearly loves the trailer. She and Linda laugh a lot at it. This is my first indication of the laughing and giggling that three girls in a room can produce.

MADDIE: Now that's good!

Q: What makes it good?

MADDIE: Well, usually I like it when that kind of stuff happens. You know when they sing songs. When you can… I like internets that do that. I love that, it always makes me laugh.

I prompt her to read the introductory text, which she does. When she reads the part about the music videos, Linda says "oohh…" with interest. Maddie rolls her cursor over the folders to hear the swoosh noises repeatedly. Then, she selects the Case of the Kid Who Knew Enough. I am pleased she is starting with stickers, because she told me earlier that she liked coloring pages.

At this point, the web use transforms from one of a single girl in front of a computer to a social experience for all three girls. Though Maddie is "in charge" by using the mouse and talking with me, the interaction between the girls is a major part of her experience. As Maddie begins designing stickers, pulling items from the navigation tabs with ease, she adds her own special sounds while picking different things — each time she does this, Rena and Linda giggle excessively. At some point, it is clear that Maddie likes making the fun noises and hearing them, but especially enjoys performing them for

the other two. Rena and Linda give suggestions about what to put where. Though Maddie never really gets the hang of keeping images from piling on top of each other on the sticker, she is clearly enjoying herself. She puts some thought into each sticker, though each item she selects seems to be another excuse for her to make more fun noises.

> MADDIE: Okay. Let's go. La, la, la. Pictures. More pictures, dum de dum, oh, pictures. Wait. Background. Dum de dum. Da ta tee da! Nah. Pictures. Blah, blah, this one. Wash your hands. Da ta de da. MMMMM. Ah, this one. That one. Whoop. All right. Backgrounds. Wait. Oops. Oops. Now this one! Bap, baap. What's this? Ah. Um. Ahhh.

She easily selects the "this one" button to change stickers to decorate. She is humming to herself while she is playing. I think she would like songs playing while she makes stickers. There is lots of laughing among the girls while playing, pretending to be the voice of the refrigerator, for example. The fact there are images stacked one on top of another is very funny to them. They are not actually reading any of the text in the word blurbs, just putting them on the screen.

Maddie's mom comes in as she begins the next game, the BAC shooting game. Her mom supervises some of her reading, correcting her mistakes. As Maddie begins to play, her mom offers guidance, preparing her to play and reminding her to use the ice cube. Her mom tells me she usually hangs around while Maddie plays on websites. I have not thought of the parental interaction that happens with kids on sites and wonder how this will change the experience of the three girls. Her mom praises Maddie when she does well and finishes a round. Maddie's mom is not able to stay for the whole session and soon returns upstairs to tend to Maddie's younger brother.

While Maddie is playing the shooting game, there is a lot of giggling among the girls. Sometimes, Linda hums along with her, but there are squeals of delight when she makes a "hit," and lots of laughter. She develops a simple strategy of shooting each BAC once, trying to hit it. She puts a lot of effort and seems a little tense about it, though clearly enjoying it. Maddie loses this round and heaves a heavy sigh, as if to say, "whew… I'm done." Maddie seems to get at the essence of challenge embedded in the game.

> MADDIE: Well, it was a little easy. Because sometimes I went a little slow, and it was also fun when they went fast, that way it would make you think a lot quicker. Like get that one! Get that one. It was also exciting.

Maddie selects another game, the matching game. She makes a match and gets her first informational blurb – a joke. She reads the joke aloud, but does not seem to get it. Again, she likes making sounds that "match" the sounds on the screen. As she continues to make matches, all of the girls enjoy looking for the matches and making sounds when matches are made or missed. Maddie clicks right through all subsequent blurbs, not reading any of them. As she clears the board of cards, she does read the information on the background screens. She plays the game twice. The girls giggle with each match and cheer Maddie on as she looks, plays, and makes fun noises for each card.

She exits and returns to the main screen. She exits and chooses "Filthy Fingers." She is unfamiliar with the word "filthy." She gets hung up on the directions — not sure what they mean. She is also unfamiliar with the word "plunger." She is enthusiastic about the game. Though Rena, the younger sister, is sometimes distracting in the background, both Linda and Maddie have their full attention to the screen. Although she plays the game

three times and discusses her options with Linda, she has difficulty understanding she should make her best guess, find out how many she has wrong, then make changes. Linda coaches her with good suggestions, yet Maddie does not take them and exits the game without solving it. Despite her unsuccessful attempts in finishing the game, Maddie seems to have a lot of fun playing. The girls especially loved the rollover sounds, such as the burp.

Maddie notices that, when they return to the main screen, the matching case is "solved" but the other two are not. I explain that in the sticker-making activity, they have to print stickers to solve the game. Since their printer is not hooked up, I show them how to cheat and solve that game. Maddie says she'll come back to solve the "hard" handwashing game.

As the girls move into the BAC TV section, I almost regret the decision to include a cat that meows on the sound rollover (a sound effect that plays when the user moves the cursor over an area of the screen). Maddie rolls over the cat to hear the noise, and the girls laugh and giggle. She rolls over it again, and again, and again… about 10 more times. The girls all make the meowing noise, and roll over it again. Here it has stopped being a computer game and is simply a prompt for giggly-girl silliness. Finally, Maddie clicks on the first song on the left. The girls all laugh at the animations and dance and try to sing along.

MADDIE: La, la, la, washing fruits and vegetables. Who's singing that? Britney Spears?

Q: It is ***not*** Britney Spears, I will tell you that. What did you think of the song?

MADDIE: Good.

Q: Did you like it? Did you think it was different?

MADDIE: It was good. Let's try a different one.

They want to go to another song right away. Linda is dancing. They love the tomato hitting the fridge. Linda is dancing and singing along. Maddie loves the song. They are enthusiastic about the songs, listening to all five, then repeating more randomly. There are specific things they really like and laugh at, like the police captain singing along, lip-syncing with the words of the female singer.

MADDIE: Oh, fight back! La, la, fight back, fight back, fight bacteria. [singing and laughing throughout the song. When song is finished…] I like this song a little but it's like preaching.

They select the "Cook It Song," while waiting for it to load…

RENA: I think I'm going to like this one!

LINDA: That's what you said for all of them!

They sing along with the song and sing and laugh all through it. They roll the cursor over the cat several more times, and they try to click on other things in the screen: the light, the windows, other things, looking for fun noises. Rena is full of suggestions. "Click this… click that." Linda says, "No, let her do what she wants." They all engage in another round of trying to sound like the cat meowing.

Maddie returns to the main screen and begins repeating games. First, she plays the matching game where she still clicks "ok" on the information blurbs without reading them. In fact, it has become a game for Rena and Linda to yell out either "GOOOOOD choice" when she makes a match or "BAAAAAAD choice" when she does not. All three roll their eyes and shout "Ohhhh, KAY!" when clicking out of the information blurb. She

reads the background text again after clearing the board and moves on to play the shooting game again.

In the shooting game, she refines her strategy, selectively shooting the oven or the soap pump to get the right tool. Now, she shoots straight to kill everything. Her strategy has changed and she is doing pretty well. In one round she gets 90% instead of 100%. There is a pause between her and her friend, and they decide to celebrate anyway.

Maddie continues playing and Linda looks on with anticipation.

MADDIE: Oops. I like. Oo, that was close. Whew, whoa, whoo! Yeah, whatever. Oop! Oh! Ninety! But it's smaller! Yeh, I know. [The other kids are giving directions] I'm going to get a hundred for sure! That's so close and yet so far. Keep doing it, keep doing it, go faster! Rats. Get it, get it. Oops. It's going too far. I am.

Both of the other girls are offering all sorts of advice now. I think some more feedback on the screen would help them keep track. By now, she selects the flame and clicks, clicks, clicks, very fast to shoot. "I'm going to get 100 for sure," Maddie says.

The girls' excitement builds. They analyze what is going on. Linda is explaining to Rena what Maddie is trying to do, both giving advice, "fire straight"… "don't let that one get away." She gets 8 out of 10. They all yell with much excitement. Maddie exclaims, "I was so close! I only missed two!"

The round finishes, and when she gets 100%, there is much elation and a LOT of yelling. A lot of hugging, they are very happy. They celebrate for a few seconds and cheer and yell and scream with laughter! I am shocked at how happy this activity is making them.

Maddie returns to the main screen and Rena points to the filthy fingers game.

RENA: Why doesn't it say solved?

Q: The filthy fingers? Because she didn't do it successfully,. Remember she missed three. She'd have to get all of them right before it could be solved.

Maddie returns to the BAC TV screen and rolls over the cat many more times in succession to hear it meowing. Linda brings up the certificate again. It really bothers her that Maddie has not solved the handwashing game so that she can make a certificate.

LINDA: You want to get a certificate, Maddie?

MADDIE: That's okay. [as if to say, "No."].

LINDA: If you can, try to play that game one more time and get a certificate.

LINDA: (Louder) IF YOU PLAY that one JUST ONE MORE TIME you can get a certificate.

In trying to get Maddie to discuss the game, it is difficult to get her attention and keep her from playing it again. She likes the site, as do her companions. She also reveals that she has learned a lot, including some things missed on the pre-test. We discuss some of the things she's learned, where I lead her through drawing some conclusions.

MADDIE: I think this game IS cool!

Q: What'd you learn about bacteria? Did you learn anything about bacteria?

MADDIE: Yeah, I learned that it's really bad for food and for your hands. It might kill.

Q: Where would you find bacteria?

MADDIE: Well, usually you would find food that's left out.

Q: Did you learn anything about how to get rid of bacteria?

MADDIE: Yeah, you'd have to clean and wash your hands.

Q: Are there any other ways to kill or to stop bacteria?

RENA: Uh huh….. freeze it, cook it away!

MADDIE: Let me think of some. Yeah, you could freeze it. And, yeah, you should cook it.

Q: How'd you know that Rena?

RENA: In the computer, it told me.

Linda asks me a question about bacteria and how freezing can keep it from growing. While I am talking to Linda, Maddie has lost interest in our conversation, and restarted the game, playing the opening trailer again. The trailer finishes and I ask her a question. She turns to me, while keeping an eye on Linda, who seizes the opportunity to grab the mouse and now starts playing the game on her own.

The girls play the "Food Detectives" song again. This time, all three of them crowd around the screen singing together, following the words as best as they can. Immediately, Maddie clicks the "Chill the Food" song. The three listen to it, singing along as they can, with great elation, and very loudly, even singing a bit on their own during the break in the lyrics. I think they will continue playing forever, but I am worried about the time, so I get Maddie's attention for the post-test.

Despite discussions in the previous section about what Maddie learned, her post-test does not reflect this learning. With assistance from me, she can conclude that cooking is another way to kill bacteria. She also can now answer the 2-hour rule and 20 second handwashing rule correctly, but does not recognize that knowledge as coming from the game – she even creates her own justification for why 20 seconds is required for hand washing.

Q: Say Maddie, can I ask you some more questions? Okay when you wash your hands, how long should you wash your hands

for 5 seconds, 10 seconds, 20 seconds, a minute or only as long as it takes to get them completely wet?

MADDIE: Only as long as 20 seconds.

Q: 20 seconds, okay. How'd you know that?

MADDIE: Because it might take 10 seconds to wash your hands and it might take 2 seconds to put the soap on, and it might take 8 seconds to wash the soap off.

Q: Was there anything in the game that told you that or did you figure that out on your own?

MADDIE: I figured that out on my own.

Maddie returns to the songs and plays another one. I try to get up, and hint that the session is over… we have been at it almost 2 hours now. Maddie's mom comes downstairs with Linda's mom, who tells the girls it is time to go. Linda is not happy about this and frantically tries to play the other games as fast as she can, now that she has the mouse. As I talk with Maddie's mom a bit, Maddie tells Linda's mom about the game. Linda goes right to the handwashing game. I suspect she is trying to solve it, so that she can make a certificate.

As I leave the house, walking up the basement stairs talking to Maddie's mom, I notice Maddie and Linda are back at the computer, playing the games again and talking excitedly about the experience with Linda's mom. The games are certainly a hit in this household. Though I tried simply to observe the interaction, I have to admit that I enjoyed watching the girls having a great time, getting caught up enjoying the social experience. In reviewing the transcription tapes and my notes of the experience, I laugh several times, enjoying their interaction with the game. I wonder if the game would have been as much fun for Maddie if she had played it by herself — we might have missed out on a lot of good giggling.

Joshua: Engaged Non-Learner

Joshua did not learn anything in playing the game: nothing, zip, nada. It is not because he was not bright or competent on the computer: he was anxious to show me the PowerPoint presentations and AppleWorks brochures on a variety of topics that he creates "just for fun." It was not because he did not have room to learn: though familiar with several hand-washing situations, he underestimated the required time for hand washing, and did not know how long leftovers could be left out before putting them in the refrigerator. His lack of learning probably did not stem from engagement in the game: He spent time in each of the games and songs, and even suggested he would recommend this site to others. It may just be because the site was about football, but I am getting ahead of myself.

The day we meet, I walk into the elementary school to find a friendly boy wearing one of his 17 football jerseys. We agreed to meet in his mother's classroom at his elementary school. After class, he regularly spends time waiting for his mother to end her day. He works on homework and takes advantage of the high-speed Internet connection to download photos and graphics that he will use in PowerPoint presentations later. When his mother and I walk in the door, he immediately stops what he is doing to stand up and come greet me. He is extremely polite, with bright eyes and an enthusiasm unexpected for a fourth grader at the end of a school day. He is not overly talkative, perhaps even a bit shy, yet he is interested in the prospect of working on the computer with me.

While he signs the consent for the study, I pull out my laptop to take notes. He immediately looks up and offers an excited "oooohhhhh," as if I have brought an especially well-regarded wine to a food critic's home. That opens an easy conversation

about computers, where he happily shares some of his work with me. He shows me the PowerPoint presentation, complete with animations and fun sounds, that is a tribute to his father. His brochure is about Elton John's drummer. I ask him if he ever plays games, or just works on projects on the computer. I ask him what kinds of games he plays at home:

JOSHUA: Football, and… that's basically what I play.

Q: Football, yeah, you like sports games?

JOSHUA: Yeah.

Q: Do you ever play games on the Internet?

JOSHUA: Not much.

Q: Do you ever go to like Nickelodeon, or Disney, or any of that?

JOSHUA: Not much. Not much. I used to do it a lot more, but now I do not do it much. I mean, I spend more time on the Playstation. When I'm on the computer at home, I'm usually like playing one of my CD-ROMS.

Q: Oh. What CDs do you like to play?

JOSHUA: Spiderman, football, that's basically all I play. Pin Ball.

He moves the conversation to the PowerPoint presentations he enjoys, recalling some he made about football.

JOSHUA: There are more of the games on the Playstation I like. I love making the PowerPoints. I've made four in these last two days.

Q: Oh, cool.

JOSHUA: Actually, five [PowerPoint presentations] in the last two days. One… no… four in the last two days and one the day before.

I went… I love going to football games. I went to a, I went to one of the university games last week.

I pull our conversation back to topic, and I go through the pre-test with him, then say it is “website time.” He’s very excited, and moves to the computer with a loud “Yay!” He wants to show me some of his sites from third grade. With some disappointment, he understands that I have a site for him to look at, and he enters the URL. I am impressed with his demonstrated competence. He easily navigates through the computer, opening a web browser. I give him the URL and discover the computer does not have the required plug-in. He is a little overwhelmed at all the text on Macromedia’s download page, but I help him download and install the plug-in.

Though he does not seem familiar with that process, he knows that once you start typing in a URL you have been to before, the browser tries to guess what it is and fill it in for you.

He hits the trailer, and sticks his tongue out and goes “blah” with the diarrhea part. He reads the intro blurb. I hear him muttering a bit to himself while he reads. He continues reading and trips on words like “cases.” He is reading each instruction blurb carefully. He says, “You might want to make that size a little bigger. 'Cause like if a younger kid goes on it they might not be able to read that little sign.”

As he reads the last bit of introduction, “Good Luck, We’re Counting on You,” which is in a large, 24 pt font.. He says, “Yeah, that one's [font is] real good.”

Q: What'd you think of the trailer?

JOSHUA: What?

Q: The black, the little movie thing that you saw there. Did you like that?

JOSHUA: Oh yeah. There were some parts that like were sort of gross.

Q: You don't like hearing about diarrhea?

JOSHUA: No. [Giggles].

He selects the matching game, the Case of the Good Food Gone Bad. He plays the game once, reading only the jokes. He likes the jokes, even the one he has heard before, but they are not enough to encourage him to read the information blurbs. When an informative blurb comes up, he quickly clicks the “ok” button without reading it. He clears the board, but reads the background text about Slick, the soap, including the information about 20-second hand washing. Despite reading this, when we go through the post-test later, he still misses this answer. Before exiting the game, he comments on the text on the feedback screen at the end of the game, “That's a good font size as well.”

He moves on to the shooting game, the case of the BAC That Kept Growing. He struggles with this game. Though he understands what to do, he seems to have some eye-hand coordination problems and has to play a couple of times before progressing to level 2. He is frustrated that it is not easier, but plays several times. He comments on the challenge of the game:

JOSHUA: I don't want – On level, I think it's level 7, you might not want to have, like the BACS coming out so fast because then it's like impossible for you to get them. I want to try one of the other games now.

Q: All right. What'd you think of that one?

JOSHUA: That one was okay. That level there was the hardest one because they kept shooting out so fast and then, your things would shoot up. They wouldn't go out fast enough.

Q: Do you want games to be like kind of hard or not hard at all?

JOSHUA: Sort of hard, and not like so, so hard. But not too terribly hard. So, I mean, if it's for like, if you're like doing, like if it's a, you should like maybe let people decide what type of level they would like. And like, so if they were like in first grade they could pick easy. Like fifth and middle school up, fourth and

middle, you would like do middle, and sort of like easy and medium. And then, for like high school up it would be hard.

Despite reading the directions in the Filthy Fingers game (even reviewing them quickly twice), he has a difficult time understanding the "time to space" timeline. He reads the text. I notice he is following his mouse along the words as he mutters the words quietly to himself. He wants to click on the arrows but then notices the rollovers in the "next" button and selects that instead.

I wonder about his reading comprehension. He should now hit the on-screen plunger to find out how many answers he has correct, but he does not seem to notice it at first, then once he does, he does not make changes before running out of time. He plays twice but does not solve the game.

JOSHUA: What? That one's more confusing cause of how the order goes. I mean, like how the order is.. it's like.

Q: You mean on that time line?

JOSHUA: Yeah.

Q: … how you tell what goes before what?

JOSHUA: Yeah.

He exits Filthy Fingers and goes back to the main screen, using his mouse to roll over all the folders and hearing the "Swoosh" noise several times. I wonder if he is feeling discouraged, commenting on the difficulty of both the shooting game and the handwashing game.

Q: What do you think of it so far?

JOSHUA: It's pretty good.

I am excited that he finally selects the sticker-making activity. Based on his love for creating presentations and brochures, I suspect he will really enjoy this game. He reads the directions, yet still has some interface issues. He is unable to delete a graphic (something not covered in the directions) and tries to click on it and hit the delete key on the keyboard, a common strategy in PowerPoint and AppleWorks. When he is unsuccessful, he uses the browser "back" button to start the game again.

JOSHUA: I'm not liking that one (meaning the sticker he is working on). This one's not as easy. This one, I think you should, like, be able to like delete some of the pictures.

Q: When you have the pictures of the fruit, you were trying to take it off and couldn't quite get rid of it?

JOSHUA: Yeah. Like that. Oh. Like that. I have to do it like this all over.

He clicks and drags the pictures to move them easily, showing a familiarity with basic computer concepts. He tries to move images from one sticker to another, instead of selecting it and pulling things out of the menus. It is hard to tell if he really enjoys the activity — he is certainly absorbed in the process of making his stickers, and seems to like his stickers. He says he does not make stickers or graphics in other programs. He continues until he makes four stickers that he likes, taking quite a bit of time with each one.

Back to the main screen, he runs his cursor over the screen looking for rollovers, then selects the "Meet the Detectives" button, reading the text. He goes through and meets each detective, reading the screen each time. Each of the detectives offer some educational blurb, such as the 2-hour rule or the 20-second hand-washing recommendation. He is silent through this whole process. He exits after looking at the four and goes to BAC TV.

Immediately, he rolls his mouse cursor over the cat, seeing the roll-over animation and hearing the “meow.” Like the folders on the main screen, this graphic is not a click-able item, only a roll-over animation. He moves from left to right, rolling over the names of the songs, and seeing the graphic change. He rolls over the cat a couple times more and clicks it, yet nothing happens. Then he selects the first song on the left, The “Food Detectives.” I see him as he is watching, his eyebrows arch up at different parts. His hand remains on the mouse, but he is not moving it. He seems pretty absorbed. He moves his mouse over the exit button, but waits a while to click. As the second stanza starts, he exits.

As he moves through the other songs, he does not listen to any one all the way through.

Q: Tell me about the songs.

JOSHUA: Well, they tell you a lot about it. They tell you like, they tell you like what it's like and what you should do to get rid of the bacteria and stuff.

Q: Sometimes you'd listen to a song longer than other times. What would make you decide to exit out of it?

JOSHUA: Well, if you like some things better than others you would like want to do that. So you might want to check all the other stuff out first and see in case you like all that other stuff. But if you really liked only one of the things, you would still want to try all of them, but go back to one that you liked the most.

Q: What about those? Did you like them, did you not like them?

JOSHUA: They were basically okay.

Q: Yeah. Would you go back and listen to any of them again?

JOSHUA: Maybe.

Q: Maybe? Which ones do you think you liked? Or which ones do you think we should make over?

JOSHUA: I don't know.

Overall, he says he likes the games, but feels the site is for younger kids who need to learn, noting it is an educational site with games. He prefers the games to the songs and the "Meet the Detectives," and says he may recommend the site to friends or return to the site.

He's been playing for 45 minutes when we stop. I ask him the post-test questions, but none of his answers have changed: he shows no knowledge gain with any of the questions. Is it the reading? I know he read information on some of the questions he was asked. He stumbled over some words. Perhaps he is just now working on comprehension in his reading. I ask him how long he can leave leftovers out, anticipating a correct response as he read that information twice: once in the matching game and once in the "Meet the Detectives" section. He replies,

JOSHUA: They said no longer than 1 hour, so –

Q: They said? Who, in the game?

JOSHUA: Yeah.

Of course, the game did not say that, but he believes it did. I assume he is not used to reading for learning but find myself surprised by his next action.

He suggests that he show me his favorite site and takes me to the National Football League (NFL) site. The content is not what surprises me — if there is one thing I have learned about Joshua, it is his love for football — it is all the text on the screen. At first, he does not open the kids' section or the games section, he goes directly to the main, text-heavy page. He answers an online survey about an impending game and reviews some of the information he enjoys.

JOSHUA: There really aren't any games I like. Usually I'll come here like every week and pick one of them [teams]. I'll answer the question on there [a weekly poll and then I'll go into the Jersey section and see if they have any new ones. And then I'll go back down [to the rest of the text about the teams].

The game he shows me is shockingly simple: five players face the user, two defense and three from "his" team, one of which has a green mark on him showing that he should be the one to catch the pass. As the players move side to side, Joshua has to click on the correct player. If he does, he gets the first down and has to do it three more times to win. If he misses, the game tells him he is a "butterfingers." That's the game. The entire game takes under a minute to play. I wonder if this limited challenge would be enough to engage any player who does not absolutely love football. After he shows me this one, I ask him again about games, but he tells me that he likes the part of the site where he can email players, or just learn more about the teams: both non-game activities.

It is probably unfair for me to conclude that Joshua did not learn from the game simply because it isn't about football. Yet, there is a relationship between interest in the subject matter and motivation to learn: I observed him reading content in the Food Detectives site, yet he was unable to correctly recall it on the post-test. He tells me he enjoys reading the content on the NFL site and I assume he can recall facts from that. He obviously enjoys some learning activities even when he could be playing computer games, he generates text for his computer projects, just for fun.

Why did Joshua not learn? I cannot say for sure, though I think it is about motivation. During our observation session, he politely responded that he enjoyed the games, and I observed that he was engaged in playing, but he later told his mother that it was "fun, but not that fun." There may be many reasons for this: The games may have

been too juvenile, the activities may have been too different from what he usually enjoys, or — and I think this is the case — the content of the site was not of interest to him. With the football-related site, his brochure about "the best drummer in the world" and his PowerPoint presentation about his dad, Joshua had a passion for the content

Joshua's experience speaks to learning and motivation in games. I have incorrectly assumed that if users think a game is fun, their enjoyment can lead them to the content. Joshua has taught me that the model is not always that simple: sometimes content provides both the motivation for learning and the vehicle for enjoyment. I have wanted to find out if learning can be fun when a game makes it so: It may be equally important to find out if learning can be what makes the game fun in the first place.

Grace: Little Girl Grown Up

I know that kids are different. Any two kids with similar ages can have different interests, abilities, maturity levels, and outlooks. Still, when I first meet Grace in the living room of her house, my first thought is, "What a difference a year makes."

Grace was the last participant I interviewed for this study. I have met with over 20 kids over the course of developing the software, conducting formative studies on preferences and a pilot study on learning preferences. For this project, I have prepared case studies for two third graders and two fourth graders. Grace will be 11 in 3 days and is in the fifth grade. This extra year seems to set her as worlds apart from the other four participants.

This difference is not in her looks, though she has blue glitter nail polish and a trendy t-shirt with a rope choker. She still has a girlish figure and child-like bounce to her walk.

As we talk more, I see this difference is in her perception of herself, in her vocabulary, and in her computer skills.

We begin our conversation with Halloween, which she really is not “into that much” this year.

> GRACE: Oh, we already had our party. But, you can bring in your costumes if you want to for the little parade where everyone in the lower grades, in third grade, kindergarten through 3rd grade parades around the school. It's so much fun. Well, the little kids, the second graders and stuff, second and kindergarten come parading through all the classrooms. And the third graders just go parading around.

We talk about her plans to get her ears pierced while with one of her best friends this weekend and her favorite computer activities. Grace is familiar with the computer and moves through a web browser with ease, showing me her homepage, an online computer pet site. She can create her own “animals” and visit frequently, keeping them fed, playing with them, or playing other games on the site.

> GRACE: So. That's fun. There's like games and it's just like a little virtual world because you have to keep your pets. They're strange pets, but you have to keep your pets. See right now they're like really hungry because I haven't fed them in awhile. You'll go around and you feed them and you play games to earn, what's called neo-points, which is money.

She tells me about instant messaging, which she would spend most of her time doing if given two free time hours, and the weather sites she refers to regularly for her class science unit. Computer use seems so ingrained in her daily activity, it is reflected in her discussion of her friends. When at one girl’s house they play one of her other favorite games: Pac Man.

She has a maturity in the way she discusses games. She likes “multi-level games” with an “off to the side mini-game.” I have not heard other kids talk about games with these kinds of words. As we talk, I realize her vocabularymay be different, but the themes that emerge in her comments — challenge, player feedback, diversity in activity — all sound very familiar to the previous participants. She likes long-term games, like the virtual pet site, to which she can return and pick up the activity where she left off previously, as well as games for shorter seat-time engagements, like Pac Man.

We move on to the pre-test. Grace seems to have a knowledge of what is “sanitary.” For example, she says you do not *have to* wash hands after going to the bathroom, but it is just sanitary. Similarly, there is no need to wash hands before making a drink, or just before a snack. She answers the 2-hour rule and 20-second handwashing correctly, through reasoning on her own:

> GRACE: Because it only takes you a couple seconds to get your hands wet, and then you basically, like we have liquid soap, so, rub it in, just wash it off and it shouldn't take more than 20 seconds.

And regarding the two hour rule…

> GRACE: Because like pizza, this example is pizza. If it's in it's box, that box usually keeps it sanitary and it usually keeps it from rotting or anything. Like if you had a cut open cantaloupe, you wouldn't leave it out for more than 2 hours cause it would get all rotten. Same with like a half eaten apple or something.

She knows that anti-bacterial liquid (in place in all the schools now instead of soap and water due to a severe water shortage in the community) killed bacteria, as does washing food, but did not mention cooking. She feels refrigeration keeps bacteria off of food by shielding it from bacteria, rather than by slowing bacterial growth. Because

Grace feels so “grown up” from the beginning of the interview, I expect a knowledge ceiling, where much of what she could learn from the site, she already would know. Although I’m surprised to find there is still much she can learn through game play, I wonder if she will find the activities juvenile. We begin the process of finding out by starting right into the website.

She easily moves through the opening pages, reads the text and clicks the “Let’s Play” button. She likes the trailer and says it is “action-packed.” She reads all the instructions to the beginning website and moves right into the cases, beginning with the sticker-making activity. I explain the think aloud process to her, and she takes this very seriously in the sticker-making activity, giving specific reasons for each artistic choice.

> GRACE: I'll pick blue because it reminds me of my sister's room. A lot of the stuff in there is blue and, also, it contrasts with the light blue of the bubbles. Here, I picked “do you wash them” (one of the word blurbs for the stickers), because the bubbles remind me of soap, so I'm thinking soap. I picked the sink because it's “do you wash them,” and washing them consists of a sink and soap. And then the hands because it is showing you washing.

Because I have asked her to talk aloud while using the site, it seems like she is putting thought into each action, justifying it so that she can verbalize her decision to me. For example, perhaps she just picks the color green or a certain graphic because in a quick glance it catches her eye, but that may be difficult for her to verbalize. Instead, she may “come up” with reasons for her selections:

> GRACE: Um. I chose the refrigerator and the bacteria because one of the main things I think about when I think of bacteria is non-chilled food. Because sometimes things turn really nasty when you leave them out. I chose this background because it's really cool. I like that it makes it sickly green. It kind of looks like the green looks like it's darker back here, but then it's brighter like it's got a sunspot, and it reminds me of something. It wouldn't

> go really well for the word blurb right here, cause it's like popping out at you. Like the screen was normally orange, but then the screen thing just pops out at you to say something.

She cares about making them "match," getting graphics that match the word blurb and backgrounds that match the border. She prints the stickers and says she likes her stickers and the game, because it lets her be artistic – something she does not feel she is off of the computer.

> GRACE: I really like my stickers. Cause one of my favorite subjects is art, and so I like doing it on the computer. Because I'm not that artistic with my hands, so the alternative is the computer. And I like doing that because, with, when you're just doing it by hand you don't have, like, all these cool picks that, like if you're doing stamps or something by hand, you can only have one color unless you take a marker and color in to a piece. And you can do it easy just by the click of a mouse and you can have all fun, cool designs. And it's just cool.

Grace moves onto the handwashing game, the Case of the Filthy Fingers. She has some difficulty understanding the timeline concept and difficulty in understanding she needs to look at both what she just did and what she was about to do. She plays, talking through her decisions and thoughts, until she realizes the one she keeps getting wrong is that she should wash her hands *before* making a drink. Once she realizes this, she plays again, answering that one correctly, and solves the case. Her reasoning reflects the difference between her and the other participants. She puts a lot of thought into the experience:

> GRACE: That was interesting. Cause you, it was kind of like an educational game, cause you found out if you really do need to wash your hands or not. Cause, I personally thought that you didn't need to wash your hands to make a drink, but I'll think about it that there are more drinks that you should wash your hands before you drink. Like if you are just going to drink

something out of a bottle or something, you don't really need to wash your hands, cause you're just going to touch the bottle. But if you're going to make a milkshake or something you're going to use your hands, so you should.

As we move into the shooting game, the Case of the BAC that Kept Growing, I suspect she will like it based on its arcade feel, similar to the arcade quality of Pac Man. She says it is "cool" before she is even done reading the instructions. Though she read them, there are still questions for her while she plays. She says them outloud to herself, then answers them through experimenting in the game:

GRACE: Okay. Oh, I get it. You have to shoot one of the soap bottles or ovens to get that power… So this one I can't get the ice cause I have bubbles... Maybe I can… awesome!

As she plays, she continues reasoning outloud to herself, without my prompting:

GRACE: I definitely like the bubbles more than the flames because they seem to kill more effectively. With the bubbles I can get 90% of the, well these [BAC targets].

This game is interesting, it reminds me of one of the games that I used to play when I was… except that it's a little bit harder. In the game that I played when I was little the characters moved a lot slower, so they were easier to get and that made it easier.

And I've noticed that when you move up into the higher levels there are more chances to get either the flames or the soap. And one of the things with this game is I've noticed with the bubbles they cover a wider range. And so, I like that better. And there's a game sort of like this and there are waves of the things instead of just single ones running across.

She plays until she loses the game and moves on to the matching game. She is pleased with all of the games she has played so far, engaged in the activity, with occasional smiles while playing. She immediately recognizes the Case of the Good Food

Gone Bad to be a memory game similar to one she is really good at. When she makes a match, she tells me about the other memory game she has played, rather than reading the informational blurbs. Even when a joke is presented, she clicks the "OK" button without reading it. She clears the board and reads the "Meet the Detectives" background, mumbling softly to herself. Her cursor lingers on the "Play Again" button for a few seconds, then she exits the game.

Grace finds a bug in the website: BAC TV and the certificate-making activity are not compatible with Windows XP, the operating system on her computer. I pull out my laptop for her to access the files remotely on my hard drive. Though I have a Macintosh with a track pad instead of a mouse, she moves into it with alacrity, showing no hesitancy in using a different computer.

While we are making the switch, she tells me that, so far, she would recommend the site to her three best friends, that she felt they would play the site, and that the games are designed for kids her age and a little younger.

As she listens to songs, she also talks with me. She feels the songs – especially the voice – is a little juvenile, but she likes the videos and picks up on a lot of the animation details like a banana sticker on the banana graphic.

She reviews some of the games in this website, mentioning that she likes the matching and the shooting game, and comments that the games are more for her age group than the songs. Grace selects the next song and smiles at a couple of the things, noticing additional details like the disco ball ("Disco Baaaallll," she says).

GRACE: I like the dancing. I like these graphics, the dancing and the little spots moving around. I like the ice cube, I really like the dancing!

She tells me that the songs may be for a younger audience. I ask what aspects of the songs are for younger kids. She is not sure at first, then tells me:

GRACE: Right now I'm into, like, Michele Branch and Avril Lavigne: two new female artists. And so I'm into the pop generation, so I like it more. And it's kind of, like one of those songs, like, I know, when I was little I used to really like the games that taught you stuff. When I was like six or seven, and so that would, sort of be the kind I really would have liked.

Q: You don't like games now that teach you stuff?

GRACE: Well, I guess.

I ask her about the graphics on the site:

GRACE: I like that they all are sort of realistic but they've still got that animated edge to them. And I like the colors too.

Q: What do you think we should fix? If you were going to say, “Hey, friends this is a website you've got to go to,” what would we have to do before you would say that?

GRACE: Hmmm.. (pause) I don't know…. It's a cool site.

Q: Okay. Would you recommend it to your friends tomorrow?

GRACE: Yes.

Q: Do you think they'd go home and play it?

GRACE: Yes.

The incredible smells coming from the kitchen tell me the dinner Grace’s dad has been fixing is almost ready. Her mom and older sister have returned home. I get the sense it may be time to wrap up our interview as I hear their muffled voices in the kitchen.

Q: Okay. Well, I'm going to put my computer back. And I'll ask you one last round of questions.

GRACE: Hold on. Can I get my certificate?

I am surprised that she remembers, even after our conversation about the site, that she wants to finish making the certificate. To make the certificate available on my computer, I need to go through and hit the "solved" point for each game. I rush through the handwashing game to solve that game. I shoot enough BAC in the shooting game to get to round 2, and exit, knowing that will cause that board to be cleared. I quickly open the stickers, hit the "print" button knowing that will cause that game to be solved. She waits patiently watching as I go through the games as quickly as I can. I move quickly to the matching game to match them all: the board has to be cleared to get it to be solved.

Q: Oh, now I've got to match them all.

GRACE: Yeah. I'll do that.

Q: Okay, you want to match them for me?

She clears the board, making the match, but not reading any of them. She clears the board and starts to hit the "play again" button, but remembers the certificate ("Oh, the certificate") and exits instead. In the certificate, she moves around with no trouble, building a certificate, reading each blurb and selecting each graphic before creating one. She cannot print from my laptop, so once it is finished, she exits.

I give her the post-test. This time, she answers all the handwashing situations correctly, including washing before a drink. She keeps the 20 second rule and 2-hour rule answers correct from her pre-test, this time adding "At the most" to her answer on the 2-hour rule. She knows that cooking, washing, and chilling food properly all deter bacteria and says that chilling bacteria kills it by freezing it up – still not exactly correct, but more

correct than shielding it from bacteria by putting it in the fridge… a step up from her pre-test.

Q: Do you think you learned anything from playing the site?"

GRACE: Yes.

Q: What do you think you learned?

GRACE: You know, things can go bad after two or more hours. And, that if you don't cook poultry and meat to the correct amount you can get sick.

Q: Would you describe it as an educational site, or a game website?

GRACE: Probably both — educational games.

As Grace's dad walks me to the door, I notice her going into the kitchen to say hello to her mother. She has the same understated, quiet air about her with her mother that she did with me.

As I reflect on our session in my methodology log, I try to express exactly what the difference between Grace and the other four participants is: she is quieter, more shy, perhaps more mature in her persona. I was impressed with her maturity in being able to explain things — in the way she could explain what made a game fun, or why she liked a certain artist, or how different things happened, how she did things with her friends. She had a real facility for words, an ability to express things.

What surprises me is that, despite this overwhelming sense of being "different," Grace's behavior showed some important similarities to that of third and fourth graders: learning occurred, she enjoyed and was engaged in games she played— even the meowing cat in BAC TV elicited the same giggling response I had seen in the third graders. Her dad told me later that she told him she returned to the site twice on her own:

once by herself and once to show a friend. Perhaps 1 year does not make the difference I had expected it to.

Summary of Participants

Table 2 summarizes key characteristics of each participant, the knowledge gained as evidenced in their verbal pre and post-tests, and the games played. Multiple checks in the "games played" column indicate the participant returned to the game more than once.

Table 2

Participants Table

Key Characteristics	Knowledge Gained	Games Played
Julia – Rushed Enthusiasm ..... age 9, 4th grade		
· Rushes through games, then returned to them · Very verbal · Frequent game player · Loved the site, returned independently after session	· 20-second hand-washing · 2-hour rule for leftovers · Bacteria can be killed through cooking, in addition to washing	Opening Trailer ..... √ Good Food Gone Bad (Matching)..... √ Filthy Fingers (Timeline) ..... √√ Kid Who Knew Enough (Stickers)..... √ BAC that Kept Growing (Shooting) √√√ Meet the Detectives..... - *not played* BAC TV ..... √ Make a Certificate ..... - *not played*
Maddie – Game Play as Social Experience..... age 8, 3rd grade		
· Played with friend, age 9, and sister, age 6 · Social experience for the 3 girls · Loved the site	· 20-second hand-washing · 2-hour rule for leftovers · Bacteria can be killed through cooking, in addition to washing (with reflection and assistance)	Opening Trailer ..... √√√ Good Food Gone Bad (Matching)..... √√ Filthy Fingers (Timeline) ..... √ Kid Who Knew Enough (Stickers)..... √ BAC that Kept Growing (Shooting).. √√ Meet the Detectives..... - *not played* BAC TV ..... √√√√ Make a Certificate ..... - *not played*
David – Simulation Gamer ..... age 8, 3rd grade		
· Engaged during some games, bored with Filthy Fingers and songs · Voluntarily quit 45 minutes in, started hopping on one leg · Avid simulation gamer	· 2-hour rule for leftovers	Opening Trailer ..... √ Good Food Gone Bad (Matching)..... √ Filthy Fingers (Timeline) ..... √ Kid Who Knew Enough (Stickers)..... √ BAC that Kept Growing (Shooting).... √ Meet the Detectives..... - *not played* BAC TV (parts of 3 songs)..... √ Make a Certificate ..... - *not played*
Joshua – Engaged Non-Learner ..... age 9, 4th grade		
· Loves football and developing computer presentations and brochures · May have reading comprehension problems · Engaged for some of the games	{no evidence of learning}	Opening Trailer ..... √ Good Food Gone Bad (Matching)..... √ Filthy Fingers (Timeline) ..... √ Kid Who Knew Enough (Stickers)..... √ BAC that Kept Growing (Shooting).... √ Meet the Detectives..... √ BAC TV (parts of 5 songs)..... √ Make a Certificate ..... - *not played*
Grace — Little Girl Grown Up ..... age 10, 5th grade		
· Computer familiarity and maturity · Liked games, felt songs were too juvenile · Solved all cases · Learned from Filthy Fingers · Returned to site independently to share with friend	· Washing hands after going to bathroom (knew, but felt it "sanitary," not really important) · Washing hands before making a drink · Cooking, washing, and chilling kill bacteria	Opening Trailer ..... √√ Good Food Gone Bad (Matching)..... √√ Filthy Fingers (Timeline) ..... √ Kid Who Knew Enough (Stickers)..... √ BAC that Kept Growing (Shooting).... √ Meet the Detectives..... √ BAC TV ..... √ Make a Certificate ..... √

CHAPTER 5

RESULTS — CROSS CASE ANALYSIS

The preceding case studies highlighted some differences and similarities among participants in using the site. The case studies highlight what was learned by each participant, their overall experiences with the site, their computer competencies, and their familiarity with games. Cross case analysis of each section or game of the site presents differences and similarities among the participants use of the interface. Cross case analysis also reveals gaming preferences across participants.

Cross Case Analysis: *Food Detectives* Site Use

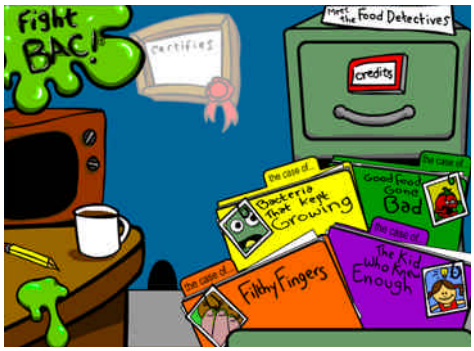
Participants were given the URL to the site, then allowed to explore at their own discretion. All participants began using the site from the introductory website, viewing a trailer, then proceeding to the main interface. From there, participants used the site in a non-linear manner, each selecting games in different orders. All participants played each of the games, and reviewed the BAC TV song section. The certificate making activity, credits, and Meet the Detectives section were not viewed by all participants.

Introductory Website, Trailer, Main Interface

Description.

Opening Website:
Users type in URL and come to the beginning website which asks kids for their help in fighting the enemy — bacteria. It also encourages them to download the correct plug-in.

Main Screen Introduction & Instructions:
A multi-screen introduction helps users identify the cases, and activities, and tells them once all cases are solved, they can create a certificate.



Main Interface:
The main interface offers fun sounds or animation when each active button is "rolled over" by the cursor. The case folders have a "schwoop" noise, other buttons jiggle. The television shows static.

Once a case is solved, that folder is marked "solved." When all four cases are solved (each case has a different requirement to be "solved"), the certificate is active.

Analysis: Introductory Website. Each participant easily typed in the URL, though I needed to spell "detectives" for all but Grace, the oldest. All 5 participants had experience with computers and the Internet and demonstrated competence in using the web browser, such as typing in the URL, using the "back" button when needed, and identifying the "buttons" on the main page. Each participant easily read the information (though Joshua, in the first of several comments relating to font size, felt the standard font size used was too small), and clicked one of the two buttons that began game play. Increasing the font size may make the main site appear more "kid-friendly."

Joshua's web browser did not have the correct plug-in to use the game. He read the screen informing him that he needed a plug-in, and recognized he needed to download it. He did not seem intimidated by this process until he went to the external site to download it. This site was fairly detailed and contained a lot of text, "Huh?" he said, upon reading it. I helped him download the plug-in, double-click it to install, and then return to the browser. From there, he was able to progress without my assistance. Children using the site will probably not be the ones downloading the plug-in if their computer does not have it. Currently, if their browser does not have the correct plug-in, they are routed to a page that explains this and provides a link to an external site where they can download it. The external site is fairly verbose and will most likely intimidate other users, as it did Joshua. The intermediary page could be rewritten to help kids better understand the download process, and encourage them to ask an adult to help.

Analysis: Trailer. The opening trailer immediately interested all 5 participants, though their opinions of it ranged from David's lukewarm reception, "It's Okay," to

Maddie's enthusiastic exclamation, "Now, THAT's good!" Grace, the oldest participant, described it as "action-packed." When restarting the site later in our session, she returned to the trailer, "I really like that intro." I think she liked the voice used in the narration of the text and the movie-like feel. Later in the game, she read the title of some of the games outloud to herself, imitating the voice.

The mention of vomiting and diarrhea also generated comments. Julia described it as gross and, with a smile on her face, said "I didn't need to hear that!" Joshua was also surprised by that element, though he giggled at the mention of it. While participants may have *said* they were uncomfortable with the mention of diarrhea, it clearly led to enjoyment, at least getting their attention.

Analysis: Instructions and Main Interface.. David, Joshua, and Maddie had trouble reading the introductory instructions, perhaps because of the vocabulary used (Maddie tripped on several words throughout the game such as "detectives" and "filthy" and misreading "can't" for "can"). Joshua felt the font sized used was too small. David exhibited a patient willingness to read throughout the site, but not in the beginning instructions. He moved his cursor over the screen, as if to learn something without having to read. Having the instructions read to them could help those with poor reading skills and those who just are not interested in reading. Removing some of the onscreen text, would make the site feel less "wordy."

Once the participants finished the instructions and entered the main interface, each rolled their cursor over the entire page before clicking on one of the cases, perhaps identifying all of the possible buttons. Several times throughout play, each participant

returned to the main interface and rapidly rolled over all the folders, hearing the quick "shwoop" noises each folder made. These rollovers are important to users. Participants depended on buttons making a sound or showing an animation, to decide what parts of the screen were active links to something else. Additionally, the sound provided a fun diversion for the subjects. More fun sounds and rollover animations could be used throughout the *Food Detectives* site and should be integrated into any children's software.

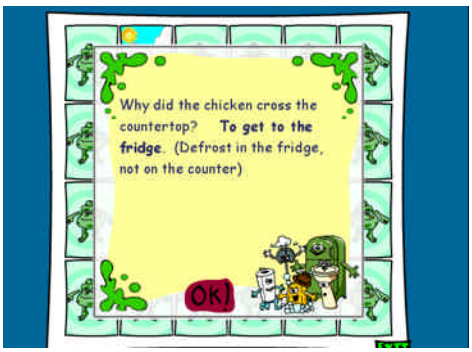
The identification of solved cases once the user had finished each case was noticed by each participant and may have influenced some to return to games to finish them, perhaps to earn a certificate. This feedback is important for the users and helped some decide when they were "finished" with the site.

The only element of the main interface that caused a problem was the BAC-TV button. Because the BAC TV Interface took a few more seconds to load than the other games, there was a delay after clicking it. Maddie rolled her cursor over the TV button and clicked quickly and repeatedly. By clicking this way, the program was unable to load, and she assumed it did not work. I explained she needed to click it just once. She did, waited the 2-3 seconds it took to load, and progressed. This should be fixed in the website, either by removing the delay, or giving a visual "clue" that the button has been clicked and the computer is processing the information.

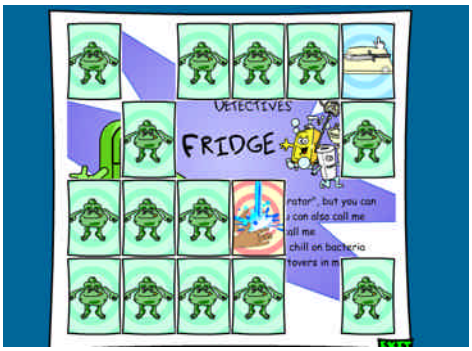
Case of the Good Food Gone Bad: Matching Game

Description.

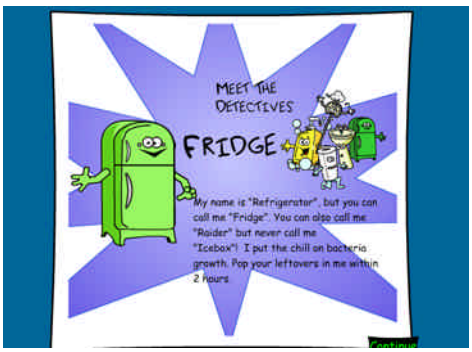
Instructions:
Introductory screen advises users to make a match.



Informational Blurbs:
When a match is struck, an informational blurb or joke appears on screen. These blurbs are randomized, so the player is unlikely to get the same blurb twice. However, each content area (such as the 2-hour rule) has several blurbs and is tied to a card. So for each content area, the user will receive some kind of information or related joke. User clicks "OK" to leave blurb.



Background Screen:
As players make a match, the background image and information is revealed.



The full background is also randomized (as is card placement), introducing each of the five food detectives.

Feedback:
After clearing the board, the user is given feedback and given the opportunity to play again or exit to the main interface.

Analysis. Each participant moved easily through instructions for this game, most recognizing immediately that it was similar to another game they had played. Participants demonstrated no problems in using the interface, perhaps because of the game's familiarity.

The greatest difference in game play is the attention paid to the informational blurbs. The blurbs can easily be skipped by clicking the "OK" after the blurb. Jokes are randomly inserted and designed to slow the reader down, providing motivation to read each blurb. This approach appeared successful with David:

> His first information blurb is a joke. David just clicks okay, without reading it. His second match brings up another joke. He takes his hand from the mouse, and reads the joke to himself. Then laughs outloud!
>
> DAVID: Listen to this! What did one sandwich say to the other sandwich? You're so full of baloney! (more laughter)"
>
> Q: You like that one?
>
> DAVID: Yeah.

As David continues playing, he gets more jokes, then additional information blurbs, yet he starts reading the blurbs. Giving David a positive reward for reading helped slow down his "click through" behavior and led him to read the content.

Julia was a very strong reader and moved easily through jokes and blurbs reading each. Joshua read the jokes, but skipped over the information blurbs. Grace disregarded

all of the blurbs, clicking “OK” immediately, starting with the first blurb. Maddie read the first joke, but seemed disinterested, skipping every blurb after that. This may have been due to the social environment surrounding Maddie and her friends.

> The girls are very happy when Maddie makes a match. When information blurbs and jokes come up, she immediately clicks on “Ok”, and does not read any of them. Later, they are getting tired of the monotonous “OK.” Showing a “boredom” in having to click “OK” each time, she and Linda say ‘Oh KAYYYYYY!’ each time, clicking through it.

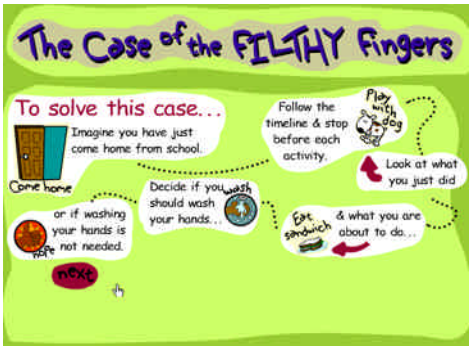
Each participant did take time read the background screen upon clearing the board. I observed no problems with the interface when participants wanted to exit or replay the game. Because of the variety in the way users responded to the information — some reading the blurbs, others reading just the background — information should be repeated throughout the game. The concentration game could be strengthened by repeating some of the key information found in the blurbs in random background images, exposing users to the content several times.

Table 2, the Participants’ Table, notes learning that occurred for each participant. David’s post-test noted only one changes from his pre-test: correctly responding that leftovers can be left out for two hours before needing to be refrigerated. As mentioned earlier, he was exposed to this information in the matching game. Julia’s post-test reflected learning regarding the 2-hour rule as well. Both Julia and David, the only two who read the blurbs, demonstrated knowledge gain regarding the 2-hour rule on their post-test; however, Julia may have learned this through the songs.

Case of the Filthy Fingers: Hand Washing Game

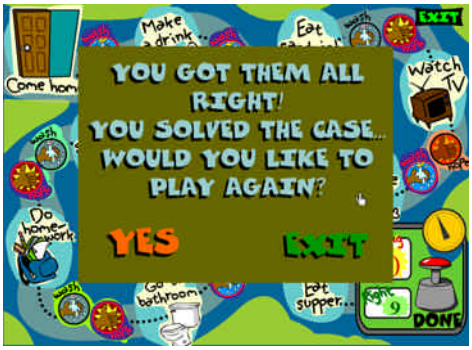
Description.

Introduction:
Instructions remind users that hands should be washed before eating or touching food and after going to the bathroom.



Continued instructions walk players through a timeline, asking them to look at what they "just did" and what they "are about to do" and decide if washing is really important ("wash 'em") or if washing is not needed ("nope"). It then tells them to hit the plunger to find out how many answers they have correct.

Game Play:
Players follow a randomized timeline (activities will be different each time) from "Come Home" to "Eat Supper." The timeline weaves around screen. As each scenario is presented, a related sound is played, and users select one of the coins: "wash 'em" or "nope" as the timer ticks on the bottom of the screen. When finished, the user can click the plunger to see how many responses are right or wrong, then making changes before hitting the plunger again.



Feedback:
If all are correct, they can play again or exit. If some are incorrect, users are told they have run out of time and given a chance to play again or exit.

Analysis. The Case of the Filthy Fingers was the least popular game in the website, and Grace was the only participant to successfully complete the game. Participants had a difficult time understanding the concept of the game play. One common difficulty was understanding the timeline, particularly in the middle part of the timeline, where it progresses across the board from right to left.

The opening instructions specifically mention that users need to look at what they "just did" and "what they are about to do," yet participants were confused by this. Some participants responded that they should wash their hands *before* going to the bathroom, when I think they meant to say they should wash their hands *after* going to the bathroom. Some onscreen prompts or hints could help users understand this and decrease their frustration.

Another common problem was not understanding the use of the plunger. Participants could answer all the scenarios, then hit the plunger to find out how many were correct and change answers before running out of time. Three participants did not understand this and waited a long period of time before realizing the timer was still ticking. Julia eventually understood the game a bit better, but was could not properly identify the handwashing instances she answered incorrectly. Again, feedback is key to helping users with this. Offering hints and reminders such as, "Great… hit the plunger when you think you are done!" could help users understand the concept of the game.

In most cases, this confusion regarding the game play prompted players to leave after the first or second unsuccessful round. Grace had some similar problems, but easily overcame them to understand the nature of the game, even verbalizing the knowledge gain:

She says you don't have to wash before making a drink and moves through the

game, mumbling to herself (“Washing before, hmm, no you do not need to”) as she moves through the activities, putting thought into each one. In the middle of the timeline, she gets stumped regarding if something is before or after. She gets three wrong.

She does not notice the timer is ticking, and hits plunger, saying “okay,” but does not do anything for a few seconds, then starts to change one of her answers. . She runs out of time and says, “Oh no,” immediately playing again.

On her second game time, she says to “wash” ***before*** but not ***after*** going to bathroom. Again, she misses 3. She says, “hmmm,” and makes one change. She then hits the browser “back” button, which puts her into the instructions again. On the first screen of the instructions, she says, “Oh, I get it!” and quickly goes through the rest of the introduction text.

On her third try, she only misses one response: she says washing is “not needed” before getting a drink.

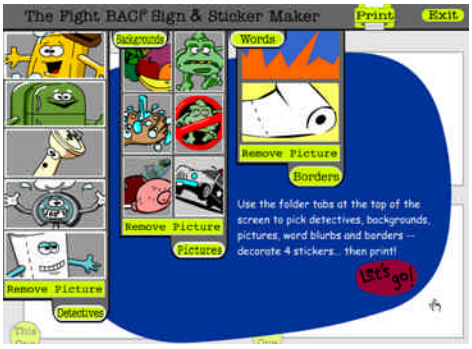
> GRACE: I still seem to be getting one wrong. I know you don't need, well, you might need to wash your hands when you make a drink. That might be what I'm getting wrong. Cause I know you don't have to wash your hands just to watch TV. I know because I have a baby cousin that you should always wash your hands before you eat. To do homework you don't need to wash your hands because all you're doing is touching a pencil. And, yes. No, you don't need to. To eat a sandwich, yes. To play with your dog, no, you don't need to. Before going to bathroom, no. Help prepare supper, yes, you should. If you watch TV, no.

She runs out of time and plays again. This time, she tries saying yes before making a drink. She gets them all right and solves the case. She seems to like it.

Not surprisingly, this game was not any participant’s favorite. Julia seemed to appreciate the challenge of it, but suggested hints and reminders to help her understand when she has answered something incorrectly.

Case of the Kid Who Knew Enough: Sticker-Making Activity

Description.



Introduction:
Multi-screen introduction shows users the tab-based interface for making stickers, and encourages them to share their knowledge with others in their home.

Game Play:
Users select backgrounds, borders, and "word blurbs" that relate to food safety and pictures. Users click one of each of the fours stickers to decorate it. To change any element, the user selects the new one from the menu. To remove an element, they select the tab and choose "Take it off."

Exit:
After printing, user clicks anywhere on the screen to "return to stickers," "make new stickers" or "exit."

Analysis. Navigation through the sticker making interface was fairly easy. Each participant was easily able to select their choices from the tabs, moving quickly from one sticker to the next. The most common problem was in removing unwanted images. Each tab had a "take it off" item, which would remove the unwanted element, but this was unclear to three users. When these three had an element they wanted removed (such as a

graphic or a word blurb) they tried clicking on it and hitting “delete” on the keyboard, hiding it behind another graphic, or just tried to move it off of the sticker. After printing, Grace did not click the screen to bring up the “exit” button. This was not a problem for her, she simply used the “back” button on her browser to return to the main interface. Standard interface elements, such as a trash can or the ability to delete an image with a keystroke would improve this game.

The sticker-making activity was popular with all participants, engaging each. Even David, generally low-key throughout game play, said:

DAVID: This is really fun.

Q: Is it like something you’ve seen before? “

DAVID: Not really, but it’s fun.“

Q: What do you like about it?“

DAVID: It’s just cool. You get to make beautiful pictures. Can I print it?“

He chose to leave three blank so he could decorate them on the printed copy once he got home. Grace, the oldest, was very concerned about making the stickers “match,” selecting backgrounds that coordinated with the graphics, that reflected the information in the word blurbs. The variety included in the graphics was important: the variety helped Grace create stickers exactly as she wanted to, and helped others feel they were really creative.

Grace seemed to especially enjoy the sticker-making activity, printing them after spending a great deal of time creating and revising her stickers:

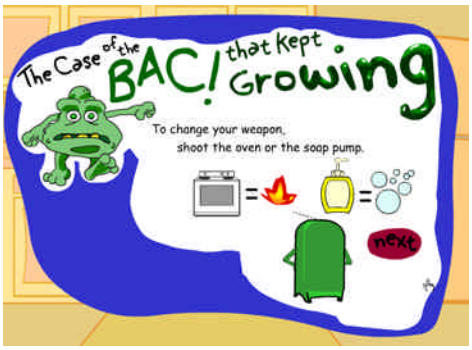
GRACE: I really like my stickers. Cause one of my favorite subjects is art, and so, I like doing it on the computer. Because I'm not that artistic with my hands, so the alternative is the computer. And I like doing that because, with, when you're just doing it

> by hand you don't have, like, all these cool picks that, like, if you're doing stamps or something by hand, you can only have one color unless you take a marker and color in to a piece. And you can do it easy just by the click of a mouse and you can have all fun, cool designs. And it's just cool.

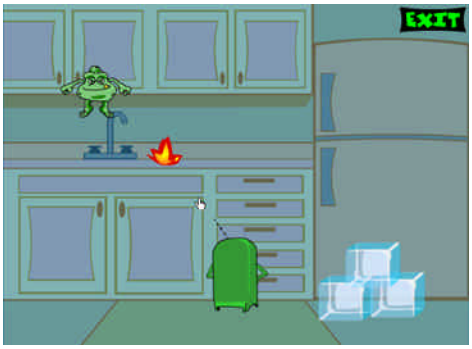
In early website design discussions, the sticker-making activity was almost removed from the website, because of concerns it would not feel "game-like" to the participants. Clearly, the decision to include it was wise. Regardless of users' ideas of what is "game like," it is wise to encourage children's creativity and provide them with opportunities to develop some of their own creations.

Case of the BAC that Kept Growing: Shooting Game

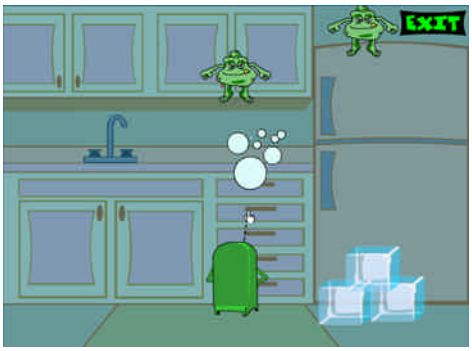
Description.



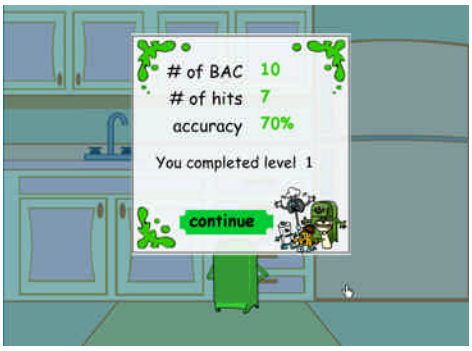
Instructions:
Multi-screen introductions explain that bacteria can be killed by the flame or by soap, shooting either the stove or the soap pump will change the weapon. Shooting an ice cube will "freeze" the action on the screen.



Game Play:
The flame is smaller, but can shoot more rapidly.



The bubbles are larger, but cannot be shot as frequently.



Feedback:
Each round offers 10 BAC to shoot. Accuracy is given to the user. If they shoot six or more BAC, they can continue to the next round. In each round, BAC move more quickly. There is no limit to the number of rounds.

Analysis. Each participant read the introductory instructions, though everyone did not seem to comprehend them well. Some immediately used the ice cube mentioned in the instructions, and others did not until discovering it in the game. Joshua and Maddie stumbled on some of the words, with Joshua declaring it was “a lot” of instructions. Regardless, game play presented no problems for any of the participants. As with other games, providing the instructions through audio could assist in comprehension and introduce users to game play more quickly.

The shooting concept appeared familiar to all the participants. Grace immediately recognized it was a shooting game from the introductions, exclaiming “Cool!” This familiarity and arcade-like feel certainly led to the game’s popularity. While it may be difficult to embed educational content into a game that depends on “twitch-speed,” the popularity of the concept is helpful in establishing users’ views of the entire website.

Joshua had some difficulty with hand-eye coordination and was challenged by the pace of the game, suggesting it be slowed down or offer varying levels of difficulty. Each participant demonstrated some kind of skill development in shooting and in developing their own strategy for succeeding in the game. For example, Grace and Julia both recognized the difference between the "bubble bombs" and the flames, and liked being able to choose their weapon.

This game was popular with all the participants. David and Joshua specifically mentioned it to their mothers as an example of what was fun with the website. Grace and Julia also included it in their favorites. Though Maddie did not recall it as her favorite in discussion following the use of the site, interaction with her friends and the feedback given after each round indicated that she found the site highly enjoyable.

While the game was obviously enjoyable for the participants, demonstrated learning is more difficult to identify. Julia quickly made a connection:

Q: Do you think you learn anything playing this one?

JULIA: Yeah. Wash your hands and cook your food.

In Maddie's post-test, she was at first unable to identify two ways to kill bacteria. I prompted her to reflect on her BAC shooting experience:

Q: Remember the game where you're shooting bacteria?

MADDIE: Yeah.

Q: Do you remember how you killed them in that game?

MADDIE: You used soap and the flame.

Q: If I asked you again… how do you kill bacteria, (Linda and Rena both want to answer, I tell them to wait). What do you say?

MADDIE: You cook it.

This forced reflection was not successful with Joshua.

Q: Okay. Let me ask you about killing bacteria. Do remember anything in the game that you did that taught you about killing bacteria in different ways?

JOSHUA: No.

Q: Okay.

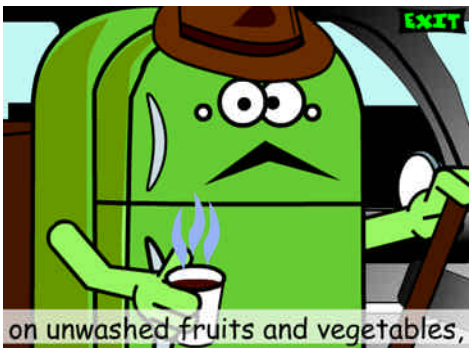
JOSHUA: You might want to suggest to put that into it.

BAC TV

Description.

The BAC TV Interface displays five songs across the bottom. By rolling the cursor over each title, the image and description in the main window changes.

The cat screeches a "Meow" and looks stunned when rolled over by the cursor.



Each of the five song animations offer song transcriptions to follow along on the bottom of the screen.

Each song is sung by the same female artist and relates to a different food safety topic: the Food Detectives, chilling the food, the Fight BAC principles, handwashing and cooking food to the proper temperature.

Analysis. The interface was fairly easy to use for the participants, though David had an initial problem noticing the songs on the bottom of the screen, pausing a few seconds

before clicking them. The “meowing” cat was popular with all of the participants, some rolled their cursor over the rest of the screen looking for similar surprises.

BAC TV yielded varying reactions from participants. Maddie and her friends clearly loved the songs, singing and dancing along with the songs, and returning to the songs section many times, playing songs repeatedly. Julia also liked the songs, at first saying they were “boring,” then “okay,” then saying “I really like the songs” and singing along with them. Neither David nor Joshua liked the songs, and neither played all five all the way through. Grace said she liked the animation and the graphics (noticing details in each song), but felt they may have been too juvenile for her preferences.

GRACE: Well, that seems like a song that’s more… more oriented with kids of a younger age group.

Q: What makes you say that? How do you know?

GRACE: Because I was babysitting this little kid and his older brother at my mom's work. And he had this game called "Freddy Fish" and they sound like that.

Joshua and Julia recognized the educational value of the songs:

JOSHUA: That makes sense. That one right there. The bacteria will follow you back any place. It sticks to you, unless you wash it off.

JULIA: I’d say the songs are really cool. It really inspires to take more care, better care of yourself. Take care of your food.

Q: Oh yeah? What’d you learn about all that? You said it inspires you to take better care of yourself and your food. How would you do that?

JULIA: Cook the food, wash your hands, chill it, just take good care of yourself.

Based on the data from participants, the songs are too juvenile for kids 10 and up. While other songs may be appropriate, the type of the song, the way it is performed and the style of the performer is important as kids develop their own music preferences. While the songs were recognized as educational by the older kids, they probably would not have listened to all the songs if I were not there, believing the songs were really designed for younger kids. Based on the success of the sticker-making activity, the older kids might tolerate the songs if they provided a vehicle for creative activity. For example, perhaps the older kids would listen to the songs if they could design a music video that could be shared with younger kids. In this way, they would be exposed to the content, but engaged in an activity they felt was age appropriate.

Other: Certificate, Credits, and Meet the Detectives

Description.

Meet the Detectives:
"Meet the Food Detectives" gives users a chance to select a detective and learn more. These screens are used as backgrounds in the Good Food Gone Bad matching activity.

Certificate:
The certificate activity (available after all cases are solved) is similar to the Kid Who Knew Enough Sticker-making Activity. Users type in their name…

… and can select backgrounds, borders, "word blurbs" and a detective before printing their certificate marking their knowledge and participation.

Credits:
From the main screen, one screen of credits can be displayed.

Analysis: Certificate Making Activity. Grace is the only user who solved all the cases during our time together, enabling me to observe her using the certificate making activity. She moved through the interface easily, quickly typing in her name and spending time selecting the perfect border, image, word blurb, and background. Because the certificate was not compatible with her new operating system, she used my laptop to do the certificate and was unable to print. She said if she could have printed, she probably would have put the certificate on her bulletin board in her room.

Though no other participants successfully solved the cases, Joshua and Maddie's experiences speak to the motivational nature of having an activity dependent on completion of the rest of the cases. Joshua was not motivated by the certificate to return to the unsolved Filthy Fingers activity, but felt it might be important for others.

The interaction between Maddie, age 8 and in the third grade, and her friend Linda, age 9 and in the fourth grade, revealed a difference in the motivational quality of the certificate. The older Linda knew exactly what a certificate was and wanted very much to complete one, while Maddie was not as interested. As Maddie and I were discussing the site with her mother, after our session ended, I noticed Linda had taken the main chair in front of the computer and was frantically trying to play the Filthy Fingers game — possibly trying to complete it to visit the certificate making activity. It cannot be assumed that some sort of culminating activity is the right reward for every player, but it may be helpful to include it for those kids who are interested.

Summary: Cross Case Analysis of Website Use

Even with a small sample size of 5 participants, it is clear that users approach the website differently: Some kids enjoyed the songs while others did not. One loved the opportunity to make a certificate while others were unmotivated. The shooting game was fun for most, but difficult for another. These findings offer specific examples of what could be improved about the website and implications for developing other games for this age group, which will be discussed in Chapter 6. Most importantly, these findings demonstrate the variability in children. This website has been through formative testing and a pilot study, yet these subjects demonstrated ways to use the site, problems in navigating, and enjoyment preferences different from other users. This highlights the danger in using informed intuition in developing for children, or in the more common practice of developing something for children because "my child likes…" Not only is extensive testing important with a variety of kids, building variety into games is important: providing multiple ways to receive instructions, providing activities for a variety of game type preferences, and offering different types of songs or song activities.

Organizing these concepts into a structure that can be used for developing future games is difficult. In the following section, I present some of the themes that emerged through interviews with subjects, not just about the Food Detectives website but about their game preferences. These preferences are organized in a way that can lead to game development guidelines, presented in Chapter 6.

Cross Case Analysis: Gaming Preferences

Although interviews with each participant included discussion about their favorite websites and games, identifying their "ideal" games was not a major focus of this research. Through discussion and observation of their use of the *Food Detectives* website, their recommendations on how the site could be improved, and short discussions about other games, several gaming preference themes emerged.

I reviewed the transcripts and my observations notes in nVivo Qualitative Software. Using the software, I coded the comments based on themes that emerged. Using a free-coding technique, I created codes based on language in the transcripts and my observation notes. I coded each document once while generating codes, then reviewed each document twice again, re-applying existing codes. These original codes are listed in Table 3, Emergent Codes

I re-organized the transcripts, organizing the passages based on code, then created refining categories for the codes based on similar characteristics and natural patterns. These refining categories appear after Table 3, with examples from each of the emergent codes, and a summary statement for the refining category. This final organization forms the basis for game-design recommendations made in Chapter 6, *Conclusions.*

Following Tables 4-11 are examples of quotes from the transcripts and observations notes for each original code.

Table 3

Emergent Codes: Preferences in Game Play

Original Codes (grouped by refining categories)		
Engaging Activity Action Active clicking Attacking, shooting, war Fast moving Education is fun Interaction with others Social activity	**Challenge** Challenge Competitive Risk Increasing difficulty	**Interface Use** Learn by playing Not reading instructions Browser navigation features Exploration Want to do it all
Environment and Character Fantasy Graphics Humor Surprise Sound Age appropriateness	**Control** Control Creating Develop skill Strategy-think-about it	**Variety** Different types of games Diversity in environment Diversity in tools Off-computer activities Changing content
Familiarity Personal interests Real world skills Familiarity of characters Similarity to other games	**Feedback** Reward Score Feedback Earn something Success	

Engaging Activity

The first natural grouping of the emergent codes reflected comments on the type of activity embedded in the games. Data coded in this refining category (see Table 4) reflected preferences related to the speed of game play, the type of activity they would be involved in and their perception of the activity.

Table 4

Refining Category: Engaging Activity

Original code is shown in bold, with examples of data provided.	
Action	
JULIA:	I'd say I'd like to get to slide like down this mudslide and jump over this pool, I think that would be pretty cool.
MADDIE:	Yeah. You could build your own rocket and then you could race it.
Active clicking	
Maddie goes to the BAC TV button: she clicks, clicks, clicks so quickly, it starts loading the movie every time, never letting it load.	
Attacking, shooting, war	
David says he likes attacking things, and wants to control an army, "like if you had an army of things that kill bacteria and bacteria had a big army and would fight back against them."	
Fast moving	
David says the game wasn't "exciting" enough: he liked it, but it was slow moving.	
JULIA:	And you have to be really careful, because if you do it out of order and all of a sudden ice cream comes up! You have to be quick.
Education is fun	
Julia admits the songs are both fun and inspiring to "take better care of yourself."	
MADDIE:	Well, they're a lot of fun. Some computer games can teach you some things. Like this computer game."
Interaction with others	
Grace, if given 2 free hours, would spend 1 hour on instant messaging.	
Joshua likes the NFL website, where he can email football players.	
Social activity	
David reads a joke outloud to himself. Once he gets the joke, he reads it outloud again, for me.	
Maddie and her friends play "together" on the games.	

Game activity is engaging if it matches a user's preferences, such as David's interest in simulation games or Grace's enjoyment of social activity within games. Similarly, the action must be at the right pace for the user. David found the shooting game to be too slow, when Joshua felt it was too fast. The content can also make game activity engaging: information about football interested David, but might not interest Julia. The activity could also be considered engaging if it provides a means for interacting with others.

Grace found chat rooms and instant messaging engaging because they allowed her to communicate with others virtually. Maddie and her giggling companions interacted with each other through their game play on the computer.

Challenge

Table 5 presents the original categories later grouped as "Challenge." Some participants recognized challenge in a game, referring to it as an important characteristic. Others mentioned elements — such as competition, risk, and increasing levels of difficulty — that contribute to the challenge in a game.

Table 5

Refining Category: Challenge

Original code is shown in bold, with examples of data provided.
Challenge
David wants a variety of challenges: increasing difficulty different types of weapons, different levels, more advanced problems to solve.
Maddie finds a varied pace in the shooting game fun, from easy to hard, then easy.
Competitive
Grace's "perfect game" includes competition among players: "And then there would be the superstar for the person who had, you know, the main prize, for the person who got the most of everything. Like the most coins."
Risk
Grace thinks a ideal game would cause you to "die" if you made a mistake, having to start over.
Increasing difficulty
Julia plays one of her favorite games, noting that she likes the fact that it gets harder over time: "It gets faster and like there's two and three different things on there. I know. It's pretty quick and it'll get quicker and quicker and quicker.

Users need to feel challenged in their activity. This challenge can come from risk in game play, increasing difficulty, and competitive game play. Just as the pacing of a game

can feel different to different users, challenge is a uniquely personal standard. Julia felt that challenge in one game came through a time limit for performing tasks, and Grace was challenged through competition with others. As challenge is measured in various ways by users, it should be provided through a variety of strategies.

Interface Use

Use of the interface reflects game usability. Usability includes features that may be standard across games, like established tendencies in reading on-screen directions or a desire for access to all sections of a game, with the ability to "do it all." Usability may also be game specific, such as an interest to learn while playing or exploring. Table 6 presents comments reflecting interface use preferences.

Table 6

Refining Category: Interface Use

Original code is shown in bold, with examples of data provided.
Learn by playing
While playing the shooting game, Grace wonders aloud if she can change weapons by shooting an oven or soap bottle. Almost as soon as she says it, she tries it, realizing she can, and responding, "I can… awesome!"
Not reading instructions
Joshua appears overwhelmed by the instructions on the Filthy Fingers game: Q: Think you can follow all those instructions?" JOSHUA: It's a lot!"
Browser navigation features
Many users refer to standard web browser controls while playing web based games. Some use the "back" buttons. Joshua comments about bookmarking the ***Food Detectives*** site in his browser.
Exploration
While deciding which game to play, David notes he wants to explore, seeing what is available to play.
Want to do it all - completion
Grace specifically asks to review the certificate making activity and the BAC TV on my laptop once she notices those sections do not work on her computer. She says she wants to visit all of the parts of the site.

Users differ in how they want to learn to play a game. Some participants were happy and successful in reading instructions, while others seemed to enjoy figuring it out as they went along. Internet-based games can take advantage of web browser navigation, such as the "back" button to return to a main interface. Interfaces can provide a vehicle for feedback, discussed later, used to encourage exploration and completion of "all tasks."

Environment and Character

Perhaps the most difficult to categorize are comments made by participants relating to aesthetics of the game: graphics, game, story, and characters. Examples are provided in Table 7. Certainly, these individual components build challenge, offer feedback, or assist with interface usability. Regardless, these individual elements contributed to participants "liking" the game, without being able to explain underlying game mechanics.

Table 7

Refining Category: Environment and Character

Original code is shown in bold, with examples of data provided.
Fantasy
JULIA: Like you have to knock out these mutant bugs that come trying to get you and knock you down. And there's a superhero, it's really small, and the bugs are coming like everywhere"
Graphics
When asked ***what*** she likes about the song animations, Grace gives specifics about the detail in the graphics: the dancing, the sticker on the banana, the disco ball.
Humor
David loves the jokes, reading each one carefully, and delightedly sharing the ones he likes best with me.
Surprise
Julia continues running her character down the obstacle course on one of her favorite website games, then notices an object in front of her. She exclaims with delight, "Oooh… a blanket." I assume this is a good thing.
Sound
Describing a fun game, Julia demonstrates how it would sound: "And if you by accidentally step on a tick, you go like this: 'boing, boing, boing.'"
Maddie is adding her own special sounds while picking different things: each time she does this, Rena and Linda giggle excessively. It makes me think she would love hearing a noise for each thing she selects
Age appropriateness
Grace remarks that the songs seem designed for younger kids, based on songs she's seen on other children's software.

Several components make environments and characters enjoyable: make-believe, interesting graphics, humor, surprise, and sounds. There is a lot of duplication within this

category: a sound can be surprising or humorous. Graphics can contribute to the fantasy or shape a character. These elements are the unique style a game contributes, speaking to uniquely personal preferences of the game user.

Control

Users like control. They appreciate making selections, designing their own creations, even having the opportunity to build their skill or shape their own reasoning. Table 8 presents preferences relating to control.

Table 8

Refining Category: Control

Original code is shown in bold, with examples of data provided.	
Control	
Q:	So you like being to pick what you're going to wear?
JULIA:	Yeah, you can pick green, blue or red or yellow. They're all the colors of the rainbow.
Creating	
One of the things David likes most about the sticker-making activity is that he gets to create things, "making beautiful pictures."	
Develop skill	
Grace reflects on one of her favorite games. At first, it was hard and she had to learn how to use the keys, often watching her fingers type, and having to alternate looking at her fingers and the screen. Once she became more familiar with it and had developed skill, she felt she was able to play the game, without having to worry about where her fingers were on the keyboard.	
Strategy-think-about it	
I ask Julia how the shooting game could be improved:	
JULIA:	Well, if you had like five ice cubes cause they use them up fast. Maybe, you know, like a few more soap bubbles. Like you would show how many soap bubbles you have left.
Q:	Oh, so you would have a count on screen?
JULIA:	Yes, so like you have to use carefully how many you have.
Q:	Oh, so you could strategize, huh?
JULIA:	Yeah.

Users like to feel in control of their game play by creating their own characters and projects, developing their skill in the game play, and thinking through problems to solve them. This control is valued at all levels of game play: from selecting wardrobes for game characters to making uniquely individual choices in game strategy. This level of control is empowering to the user, making the game more engaging.

Variety

The most obvious theme in emerging codes is that of diversity. Participants noted the importance of choice in types of games, environments for the game to be played with, diversity of tools, even in types of activities offered through the game. Table 9 offers some of these preferences.

Table 9

Refining Category: Variety

Original code is shown in bold, with examples of data provided.
Different types of games
David remarks that there are types of games he likes to play, and that the Filthy Fingers game is not one of those types.
Maddie notes that a variety of activities would make up her "perfect game:" coloring, rockets, books, the ability to read or be read to.
Diversity in environment
Maddie recalls the last fun game she played, rocket racing: "You could decide which speed you want to go to and where you want to race. You could race under water, in town, in, all around the neighborhood, in space. And sometimes you could do it in Jimmy Neutron's dad's brain. Now that! That almost made me throw up! I tell you. "
Diversity in tools
Grace reflects on why she liked the shooting game: "I like that… you get like different tools and stuff, because that seems more like my age kind of games. "
Off-computer activities
Linda is "washing' her hands" on the washing song, using physical activity to supplement what is going on in the computer game. Later, the girls all meow like the cat.
David prints his blank stickers, to color at home later.
Changing content
Joshua explains the NFL site to me. He says he likes to come every week and see what has changed: the poll on the main screen, the types of football jerseys that are available, or new games.

Game play is more enjoyable when options are presented: users can select from different types of games or games which are frequently updated, play in different environments, use a variety of tools, even engage in related off-computer activities. Even David, the participant with an obvious preference for strategy games, recognized the importance for diversity: he wanted the same *type* of game, but in a variety of environments.

Familiarity

While diversity was a common theme in game preferences, participants also noted the value of familiarity. Familiarity (examples given in Table 10) included characters or games they had seen elsewhere or personal interests that correlated with game content. Familiarity also comes in recognizing game tasks like math or strategy as relevant to real world activities.

Table 10

Refining Category: Familiarity

Original code is shown in bold, with examples of data provided.	
Personal interests	
Joshua notes that he likes football games, and sports games, mostly any games about football, his favorite pastime.	
Real world skills	
DAVID:	I like the real time strategy things. You know how you can do a math real time strategy game? Every time you have to build a team plus how much the unit costs like, 5 plus 5, or 5 times 5, those sort of things. Question when you try to get a unit. ”
Familiarity of characters – ideas	
GRACE:	Um. So, okay. I like this [shooting game] because it's bubbles and it reminds me of Spongebob [Squarepants]. ”
Similarity to other games	
Julia, like most of the participants, jumps right into the matching game, noting its familiarity with other games they’ve played. Julia says she likes it because of that similarity.	

Interest in games increases when parts of the game feel familiar, perhaps the content is of personal interest to the player, the activities are in context, or characters or game play are established elsewhere.

Feedback

While no participant specifically mentioned feedback, they recognized techniques commonly used to provide it. Participants liked knowing how they were doing while playing, how they did when finished, and how they could improve their game play strategies.

Table 11

Refining Category: Feedback

Original code is shown in bold, with examples of data provided.
Reward
Julia likes her obstacle course game, especially at the end where she receives a medal for her performance.
Score
In another web game, Julia reflects on the score she got, both her time and her overall score.
Feedback
Maddie and the girls wait with anticipation to see how well they did at the end on specific round in the shooting game. After getting 9 of 10, they are thrilled.
Earn something
Grace's favorite site, Neo Pets, gives here the opportunity to earn "neo points," something that can be used to "buy" stuff elsewhere in the site.
Success
After struggling to find the one thing she kept answering incorrectly in the Filthy Fingers game, Grace is pleased to see the on-screen sign that tells her she has finally answered them all correctly.

Users appreciate working towards rewards or a score and appreciate the chance to grow through their game. Feedback should chart progress and encourage continued activity, assisting the user in making appropriate decisions.

Summary: Cross Case Analysis of Gaming Preferences

Providing categories for gaming preferences is a highly subjective endeavor. As reflected in the literature in Chapter 2, there are a variety of categorizations for what makes a game fun. Within this study, there is some overlap among my categories. For example, a preference for a certain kind of content, such as Joshua's football, can make an otherwise hum-drum activity engaging. Similarly, a passion for football can call upon a user's preference for familiarity in games. Engaging activity can be made even more compelling by an interface that offers adequate feedback. While overlap across categories exists, the names of the categories — even the selection of the specific themes within — are not as important as the concepts expressed and summaries used to develop guidelines.

The categories — Engaging Activity, Challenge, Interface Use, Environment and Character, Control, Variety, Familiarity, and Feedback — are offered as an organizational structure. Additionally, the importance of repeating educational information and involving potential users in the design process is highlighted.

CHAPTER 6

CONCLUSIONS

The *Food Detectives Fight BAC!*® Website is nearing the end of its development cycle. It is currently being translated into Spanish, and requests for it on CD-ROM (largely by food safety educators in schools with uncertain Internet access) have prompted consideration of revisions prior to conversion from the Web to CD-ROM format. While large-scale changes could be recommended, such as re-recording songs that would appeal to an older audience, only revisions that reflect existing resource limitations can be realistically implemented. This chapter presents recommendations, noting options for making changes within a limited budget and time frame.

More importantly, this study was undertaken as a means of understanding the gaming preferences of the participants and offering recommendations on what educational games *could* and *should* look like. These guidelines are presented as a blueprint for future development; a set of guidelines for those, myself included, who want to create an entertaining and effective educational game. Findings from this study are merged with recommendations in existing literature.

Finally, this study has prompted new lines of inquiry regarding the effectiveness and appeal of the *Food Detectives* website and the methodology used to conduct this study. The suggested research holds potential for educational gaming research in suggesting effective evaluation processes, assessing existing evaluation procedures, and proposing game design strategies. Because the recommended changes to the *Food Detectives* website offers a context for the more general guidelines, they are presented first.

Recommended Changes to *Food Detectives* Website

Overall, the site was liked by the participants in the study, with at least two of the participants returning to the site on their own unprompted, and each participant enjoying at least one of the activities. Of the participants, 4 of 5 learned something. While participants in this study used the site at my request, if experiences of other children using the site in their spare time reflect the experiences of study participants, this game *is* educational and has reached an important audience with an educational message.

Despite the apparent success of the program, it has several weaknesses: one game, the Case of the Filthy Fingers, confused all of the participants; much of the educational information in the matching game was lost on participants who did not read the informational blurbs; and instructions throughout the site were a barrier for some participants. The following recommendations suggest minor changes that can improve the game play without significantly altering the existing design or activities included. They include suggestions made for the Internet version and possible directions for adaptation to CD-ROM.

Introductory Site and General Recommendations

Text proved problematic on several parts of the site: David wanted larger text, Maddie stumbled in reading some of the words, and Grace breezed easily through the reading without fully comprehending what she read. Where text is essential, as it is on the main page, the font size should be increased.

Dempsey, Lucassen, Haynes, and Casey (1996) asserted that games require clear, concise instructions to play the game. Participants in this study indicated that instructions should be condensed, providing only the most necessary information. In the shooting game, instructions were provided on changing weapons and using the ice cube, yet two participants (who read the text but did not seem to internalize the information) still delighted in discovering this in game play, perhaps because that discovery is part of the fun process for kids.

Where possible, on-screen text should be partnered with audio narration. The large size of audio files may make this solution impractical for the web-based version of the site, but the CD-ROM should include audio narration of all on-screen text.

Users with browsers that do not have the Macromedia Flash Plug-In must go to the Macromedia site to download it. Unfortunately, that site is not kid-friendly, and may even be intimidating to adults. As Joshua had difficulty with this first step, the *Food Detectives* site should include a revised "You Need a Plug-In" page encouraging users to get an adult, describing the need for a plug-in, and the processes involved in downloading it. Because of the challenges described with text, this information should be concise and easy to read. This change is consistent with Harbek and Sherman's (1999) recommendations for websites for young children, in designing some Internet activities to include an adult. These challenges are consistent with adults and children: Nielsen and Loranger (2002) found the common problems adults had in navigating Flash-based websites were a lack of guidance in the process and overly complex interactions.

The button for the BAC TV seems sluggish. Maddie clicked it several times, prompting that part of the site to continuously begin downloading. The BAC TV button

needs to have a shorter delay in loading the program or needs an indication that it has been clicked.

Study participants had high-speed Internet access to use the games. Julia still had short delays in downloading some of the activities. Including “mini games,” such as a simulated arcade game, could increase satisfaction and retain the attention of users with slow connections who are forced to wait while the games download.

Case of the Good Food Gone Bad: Matching Game

The largest opportunity for improvement in this game is encouraging users to “get” the informational blurbs. Informational facts could be read to users after a match, making it more difficult to exit out of each one. Because all of the participants read the background screens, background screens could be re-organized to contain the educational information. The information could also be provided through a streaming audio file that played while the users made matches, almost like a radio station in the background. Finally, short blurbs could be included on the feedback screen at the end of the game.

Case of the Filthy Fingers: Hand Washing Game

All study participants had difficulty understanding the game play for Filthy Fingers. The lengthy instructions at the beginning may be lessened by having audio narrated, but they need to be re-written to be better understood by kids. The key concepts for when handwashing is needed — before touching or eating food or drink and after going to the bathroom — need to be better emphasized throughout game play.

Feedback needs to be better incorporated in this game. Users need to be prompted to hit the plunger when finished, review and change their answers if needed, and notice when time is almost out. If users run out of time before successfully solving the board, they should be given hints regarding which of their answers are incorrect, then provided the opportunity to play again. The fun sounds in this game were a highlight for the players. Audio narration should reflect this: fun sounds should be included throughout spoken text.

Case of the Kid Who Knew Enough: Sticker-Making Activity

Some participants had difficulty deleting an image, though this did not appear to deter them in progressing with sticker design or cause them to dislike the game. If possible, standardized interface elements, such as an onscreen trashcan or a key command for deleting should be included.

A post-printing interface needs to be included as well. Currently, after printing, the screen shows only the stickers, but no “exit” or “return” button. These need to be included, even if they print with the stickers.

If study participants were in control of revising this activity, they would most likey request additional images and the ability to create more stickers.

Case of the BAC That Kept Growing: Shooting Game

This shooting game was the most popular with participants and needs minor revisions. Having the introductory text narrated would be beneficial, as discussed earlier.

Encouraging reflection by the users regarding the methods of killing bacteria could improve knowledge gain. This reflection could happen through audio narration during game play, or on the feedback screen with the score.

BAC TV

The songs and animations were popular with the two youngest participants, and used by all. The style of the songs and the artists' performance may be too juvenile for kids older than 10 years old. Though final revisions of the website may not realistically involve alternative activities for older kids, future versions could involve a video-making activity for the songs, alternative recordings using different performers, or an opportunity for users to build their own songs by selecting from numerous pre-written stanzas.

The rollover "meowing" cat was so popular, participants rolled their cursor over the rest of the BAC TV Interface looking for similar surprises. Adding more "hidden" rollovers could increase satisfaction with this activity, and with the site.

The importance of the recommended changes to the *Food Detectives* site lies more in implications for design of future sites than in continued improvement of an existing site. These implications may be of broader interest to a developer, especially after reviewing user experiences of *The Food Detectives Fight BAC!*®

Implications for Creating Educational Games

Observed game play by participants revealed preferences relating to interface use, feedback, environment and character, engaging activity, challenge, control, familiarity, and variety. While the organization of the themes is somewhat flexible — these categories could be renamed or possibly reorganized — this structure provides a useful framework for offering design recommendations for educational games.

Interface Design Is a Key Consideration

Participants enjoy learning through game play, receiving information as needed. Though they may be willing to read instructions, it cannot be assumed all will. Game interfaces should provide opportunities for user exploration and learning-by-doing, while still granting the opportunity for more detailed help when requested.

Game interfaces should also reflect existing interface standards. Games delivered through a web browser can take advantage of navigation features offered by browsers, such as the “back” button, and opportunities to bookmark a site. Even though these features may not be necessary components of game play, designers should realize that users will default to these conventions when confused. For example, when Grace did not know how to exit from the sticker-making activity to the main screen, she hit the “back” button on her browser. This routed her through the instructions for sticker making, then finally into the sticker-making activity, where she exited to the main interface. Internet game design should not impede use of browser controls.

Finally, interfaces are key vehicles for feedback. Click noises or special sounds can help users know when a button is active. Users want to know where they are currently in the larger scope of a game. Providing feedback relating to what activities they have already engaged in at a games site, such as the "solved" sign on the case folders in *Food Detectives*, or indicating how many additional games are available are appreciated. Incorporating this visible reassurance through the interface is one way to provide important feedback to users.

Gilutz and Nielsen's report regarding usability of children's websites reflects the importance of interface design (2002). Among their 70 design guidelines, several mirror opinions of study participants, use standard interaction schemes, use large fonts, provide instructions that are always accessible, consider rollovers, offer strong "you are here" feedback on the interface, and make clickable items look clickable. The best approach in developing gaming guidelines is to depend on existing usability guidelines.

Games Should Incorporate Feedback Throughout Play

Users want to know how they are progressing through the game, how they did when finished, and how they can improve. Scores, rewards, and motivational comments can accommodate users' need for challenge, as well as offer incentive for continuing game play. Similarly, feedback helps users develop skill in game play and learn through activity. Feedback can encourage reflection after a game, as recommended for the *Food Detectives* shooting game. It can also help them reflect on their strategy and approach. Users should get hints when they are not performing as expected, visible measures of their success, and recommendations on how to improve their game play.

Feedback is a key component of several elements of game design: challenge and competition depend on feedback to guide the user through challenges; users utilize feedback in taking control of a game, interfaces can rely on feedback to help users understand where in the game they are currently exploring.

Environments and Characters Are Important to Users

Participants noted the importance of graphics, humor, surprise, sounds, and fantasy elements in game play. It is important to note that, when asked to specify what kind of graphics are best, what fantasy elements should be included, or what kind of humor is important, participants did not elaborate. This presents an open-ended challenge to developers, as well as opportunity. Seasoned "gamers" like David have seen fancy 3D graphics, and Grace is familiar with professionally produced animation, yet both liked the simple graphics on the *Food Detectives* site.

These findings have two implications for designers. First, site design should not be constrained by current design trends. While participants may like the graphics in the top-selling console game, they may not require that level of graphic finesse or even that style to enjoy the game play of a new game. Existing research supports this recommendation: Rieber, Davis, Matzko and Grant (2001) found that, though children appreciated high-quality graphics, they are not important factors in critiques. In developing a game-like environment for the exploration of mathematical concepts with high school students. Elliot, Adams, and Bruckman (2002) found that in attempting to replicate the 3D environments of videogames, they set up false expectations for students when the game did not meet the students high standards set by current videogames. They found the

students' initial motivation to use the software was greatly decreased after the game did not meet their standards for engaging 3D graphics. Additionally, designers could "date" a game by linking it too closely to a currently trendy look. The lesson learned here is that graphics should be clean and appealing to the user, but production values that "push the envelope" of game design are not necessary for engaging game play.

While animation is often connected with children's media, none of the participants felt the characters of *Food Detectives* were juvenile. In most instances, they were not able to articulate *what* they liked (the color, the style, the way the characters were drawn), but they noted that the graphics were important. Designers should explore several graphical options, or look to programmers and artists to set design parameters based on technical specifications. For example, rather than forcing a first perspective 3D graphical interface, designers should listen to what is best for delivery. If files will be delivered via Internet, graphic designers and programmers can recommend the most efficient type of graphics for downloading.

Second, formative testing of environments and characters with children is key. Because it is difficult for users to predict what they will like, prototypes can help designers know if they have hit the mark or need another approach.

Correctly designing the characters and environments can help the activities feel intrinsically related to the user, offering a useful metaphor and fantasy that is emotionally appealing — all key elements of game design. Individual game elements also arouse curiosity in players, by offering surprises, rewards and constructive feedback (Malone, 1983)

Games Should Engage Users With Activity

This statement is obvious to the game developer: for an educational game to be "fun," the activity must be engaging for the user. The less-obvious aspect of this objective is in anticipating what types of activities will be engaging for the user. Jones (1998) notes various types of engagement, including a user's personal reasons for being interested in the game, being personally interested in the content. He defines engagement as the combination of initial interest and external stimuli that encourage continued use. Thatcher highlights active experiences as crucial in educational software, viewing active engagement as the use of acquired knowledge (Thatcher, 1990).

The participants in this study want to be active during game play. They want to be clicking more than reading, moving the mouse more than keeping it still. Action should be appropriately paced for the user and give them a sense of control. Joshua and David both wanted to attack, to have armies, or to fight battles. Grace wanted active communication with her peers or with a "virtual" companion, such as her Neo Pet. Jones research reflected this, noting that learners should be "doing things in the software," such as accessing graphics and text, and clicking and dragging (Jones, 1998, p. 110).

Csikszentmihalyi's (1993) flow theory proposed that engagement can be reached by placing individuals in a state in which they lose themselves in the state of flow: where challenge and skill meet. Yet engagement extends beyond the challenge and skill traditionally associated with games and into other types of activities initiated by the computer interaction. Social activity can be a large part of computer interaction through games. Maddie's group certainly enjoyed playing the game together and interacting with each other. Games could encourage this activity by developing games to be played by

multiple players, encouraging physical activity of users while they play (such as Linda's "hand washing" during the songs) and offering communication portals as part of their games.

Users enjoy learning when they feel their learning leads to visible results. David enjoys simulation games because he feels they have real-world applications. Grace enjoys learning new things and being able to share that information with her friends. Julia appeared to enjoy the information she learned through the songs and the ability to recount what she had learned in our conversations.

Engaging activity is also built into games by offering challenge, control, variety, and familiarity.

Build Challenge Into Game Play

Users want to be challenged by games. This challenge can come through increasing difficulty levels, more advanced problems to solve as game play progresses, or offering different types of weapons or strategy solutions. Challenge should include an uncertain outcome and have personally meaningful goals (Malone, 1983). Competition among players can offer challenge, giving a measurable goal to be achieved. Malone noted that competition with another person or with the computer offers motivation because it offers challenge at the appropriate difficulty level. Risk can build challenge by forcing a player to start again or rebuild a character after that character dies.

Csikszentmihalyi's (1993) flow theory recognizes optimal experiences as those in which the challenges faced matches the skills needed. These '"flow like activities" must have clearly stated goals, opportunity to adjust action to the user's own capabilities, clear

feedback, and a screen for irrelevant distractions. Challenge in game play can be created using these goals as a guide. Feedback is essential through several elements of game design and a key component of building challenge.

Users want the proper balance between their skills and the challenge at hand; one game could challenge two separate users in two different ways. Because players are unique, what challenges one player may not challenge another. For example, some participants found the bacteria in the shooting game were not moving quickly enough; others felt they moved too quickly. Giving users the ability to control their challenge level may help make the game more engaging, and the challenge most appropriate. This element of control is important in other areas of game play as well.

While challenge was valued by participants, it is important to note that appreciating challenge or competition does not equate with a distaste for collaborative or cooperative activities. Maddie and her friends enjoyed the social experience, while Grace highlighted the value of communicating with others through her favorite sites. Rieber et. al. (2001) concurred that cooperative interaction can have value. It assists in providing intrinsic motivation, creates an environment of support, helps individuals measure their achievement. In addition, participation in a group goal enhances individual persistence. Paley also encouraged collaborative experiences based on her observations of preschool classrooms. In recounting her experiences with a kindergarten classroom, she encourages a model of collaborative rule making regarding play in which “you can’t say you can’t play” (1992). She highlighted potential dangers of competition, in making children feel isolated, valuing success over another person rather than individual gains which success is “the extent to which the group helps each other develop and grow” (2002). While this

cooperative element did not emerge specifically as a preference of study participants, a collaborative element could blend participants interests in competition with desires for social participation.

Offer Users Control Throughout Activities

The concept of offering control to users in interactive experiences is common in instructional design research. This level of control strongly affects continuing motivation (Jones, 1998; Kinzie, 1990; Malone, 1980) and allows users to make the activity progressive and individualized (Harbeck & Sherman, 1999).

Opinions of participants in this study concurred: just as users want to be able to adjust the level of challenge to their individual needs, they also appreciate the ability to control other aspects of game play. Users should have options throughout game play, such as how characters dress or what they look like. They should be able to adjust game controls, specializing them to their own needs, such as using a mouse or using keyboard controls. Users should also be granted control over decisions; such as strategies for making decisions or executing orders.

This control does not mean users want to make only simple decisions or select from a couple of options. Giving users control also means sharing information with them. Using feedback to help them understand what they have accomplished *so far* in a game helps users control future actions. Julia wanted to know how many “soap bubbles” she had with each weapon, so she could decide how to use them best. These controls must be meaningful to game play. Allowing a user to select among five characters that only look

different but play a game the same way, is not as meaningful as granting a choice among five different personalities.

Finally, control speaks to the creative natures of users. The sticker-making activity was engaging to users because they were creating the stickers. Grace wanted to make a set of stickers that "matched," Maddie wanted to create very different kinds of stickers, while David only created one sticker, and saved the other three to color at home. Each user could control how their stickers would look, allowing some open-ended creativity.

Build on Users' Familiarity of Other Games, Characters and Content

Users appreciate the recognizable. Whether it is a game that they have seen before or a character that they have met previously, familiarity is comforting. David appreciated the familiarity of football content, no matter what kind of a game it was. If it was about football, he would give it a try. The matching game gave players confidence, because they had played the game before and knew how to play this one. In research conducted with 30 sixth-grade students, Rieber, Davis, Matzko, and Grant (2001) also found that participants seem to prefer games with a familiar context. Gilutz and Nielsen (2002) noted that kids reviewing websites recognized a specific content world from the main web page and decided quickly if they would continue: "If the topic presented interested them, they stayed and tried everything. If it did not, they didn't even check out the games" (p. 10). Websites with specific brands or characters were treated in the same way. If it they liked the brand, they stayed, and if not, they left the site. This implies familiarity must be used carefully. Although users are aware of certain aspects, this familiarity could increase appeal of the site for some or cause other to be disinterested immediately.

It is important to note that participants made several references to the familiar, but did not specifically say that new and unfamiliar things were not welcome. It would be inappropriate to base an entire game-play experience based on an existing concept.

Recognize the Importance of Variety

The most important lesson learned is the value of variety — something reflected in previous categories. Game players are different: challenge, interesting characters, and familiarity each mean different things to different people. Designers should recognize this difference by building variety into game play experience. Users should be provided with different types of games, utilizing different skills or interests. Designers should provide a diversity in game environments and characters, also taking advantage of variety in increasing challenge, introducing a new, different kind of solution for problem solving in each round, or giving users control by allowing them to design unique wardrobes.

Variety can be introduced by offering changing content or updated games, which is easy to do in Internet based games. Joshua liked the constantly changing NFL site — updated statistics, daily polls of user predictions, player updates. This variability kept him returning time and again. Gilutz and Nielsen's (2002) study found that kids expected websites to be updated frequently, both the content and the design. Specifically, their study participants noticed when websites were themed for a current holiday and enjoyed this variety.

Users may not enjoy all aspects of game design. Because users are different, some games will appeal to one that will not appeal to another. Educational information should

be repeated throughout several different types of experiences, so that all players can be reached with the educational information, despite differences in game play preferences.

Repeat Educational Information. In the *Food Detectives* site, educational information was provided throughout the game, but rarely repeated. Because users did not use the site in consistent manners, some participants were not exposed to all information. Designers should repeat educational information in different strategies throughout the game, ensuring that users will be exposed to critical information regardless of paths chosen. Repeating educational information may not only increase exposure of users to educational information, repetition can reinforce what is learned, or help students learn content in different ways.

Utilize Users Throughout the Design Process. Children can be used as designers early in the process, or in early prototyping of designs. Throughout development, formative testing can reveal the interests of users, and indicate areas for change. Once the game is "finished," additional testing should be conducted, which will most likely lead to additional changes. Each round of testing and user feedback with the *Food Detectives* website has yielded valuable information; each user provides new insight.

Druin's four key roles outlined in Chapter 2 serve as a scale for involvement of users as designers. Children could be observed while using technologies, consulted with after testing prototypes, asked for providing feedback on existing development, and retained as full design partners. Perhaps the largest mistake any designer could make is designing a

product based on their own "informed intuition" or on the experiences of their own children or recollections of their own preferences when they were children. Kids are each different. The games currently being designed can be significantly different than games currently in use. Kids today have a knowledge game history that is very different from kids who were the same age 2 years ago. The development of the *Food Detectives* website incorporated children in three of Druin's designated roles: as users, children were observed using software designed for their age group, and early design decisions were based on their feedback; as testers, children were asked to use early versions of the website, providing feedback on interface design and the appeal of the games; as informants, kids were asked to assist in recommending alternative design of the games and worked with developers to create new game structures (the Filthy Fingers Game and the Sticker Making activity both emerged from children in the role of informants). In this study, children played the role of users, while being observed and interviewed about the existing site.

Summary of Implications for Game Design. The recommendations can serve as a blueprint in design, reviewing them during the design process as a starting point for developing a game children will find engaging. Themes like feedback, challenge, creativity and interaction are incorporated into each section. The first eight guidelines regarding interface design, feedback, environments, engagement, challenge, control, familiarity and variety are based on themes that emerged from the qualitative analysis of study participants' preferences in game play. The remaining two reflect the dynamic

development process used in the *Food Detectives* site, as well as recommended changes to the program.

Interface Design is a Key Consideration: Game interfaces should provide opportunities for user-guided learning, with accessible help when needed. Game interfaces should reflect known usability guidelines, building on common interface elements and not impeding features in existing operating systems or web browsers. Game interfaces should offer feedback for users, helping game players navigate through the game.

Games Should Incorporate Feedback Throughout Play: Feedback aids users in progressing through the game, and the use of scores and rewards can accommodate players need for challenge. Feedback can also encourage reflection on strategy, approach and learning.

Environments and Characters Are Important: Graphics, humor, surprise, sounds and fantasy elements are important to users, but games do not have to push the envelope to be appropriate. Formative testing and user participation in development can guide appropriate environment and character creation.

Games Should Engage Users with Activity: Users want to be active throughout the game, with a minimal amount of passive reading. Activity can include participation and decision within the game, as social interaction with characters or other game players, and even physical activity while playing.

Build Challenge Into Game Play: Users want to be challenged through increasing difficulty levels, increased problems to solve, or competition. Challenges should meet skills of the players, so feedback and user-controlled difficulty levels assist in creating

appropriate challenge. Challenge may include competition, though collaborative goal attainment can also be challenging.

Offer Users Control Throughout Activities: Users want control of their activity, character design, even creative activities. Control contributes to users' engagement, but also in allowing users to customize the play experience.

Build on Users' Familiarity of Other Games, Characters and Content: Familiarity is comforting. Utilizing familiar characters, game rules and interface elements increases users' enjoyment. However, while some familiarity is appreciated, new and unfamiliar things are not discouraged.

Recognize the Importance of Variety: Differences among game players reflect the necessary variety in game design. Users should be granted different types of games and opportunities for utilizing different skills and interests. Updating games and website content also increases perceived variety.

Repeat Educational Information: Educational information should be presented in a variety of places and for a variety of learning styles. This repetition may increase exposure of users to educational information, increase retention, and offer learning for different learning styles.

Involve Users in Design Process: The design guidelines presented in this chapter can only be a starting point to developing a game: ultimately, frequent feedback from users is the only development guideline that will yield an effective product. This user involvement can occur through frequent testing, occasional consultation, or in using children as design partners.

Recommendations for Additional Research

Unfortunately, user testing is time consuming and costly. Research that summarizes design processes of existing sites, offers guidelines for testing methods and reflects existing trends that can help developers make the most of their testing resources.

Developing Educational Games

While the *Food Detectives* may not continue or warrant additional development, lessons learned from the program can inform others wishing to design educational games. While conducting this study, several aspects emerged which warranted future study, yet were beyond this study's scope.

A large body of research exists in gender differences, especially game type preferences for boys and girls, and use statistics. Neither boy in this study enjoyed this site as much as the girls did, and the sample size of this study limits conclusions based on gender. A more detailed study could contribute to existing research in gender-based differences.

While knowledge gains of participants were measured with a verbal, simple pre- and post-test, only immediate changes in knowledge were measured, not behavior. For example, immediately after game play, Grace reflect that she *now* understood that hands should be washed before preparing a drink, but there is no evidence that she actually washes her hands before making a drink. This kind of behavioral research in food safety education is problematic. This game site was developed assuming knowledge gain is the

first step to behavior change. Additional recommendations need to be made in affecting behavioral change in food safety, and in measuring that change.

Additional research is needed in the decision making process children use in choosing websites. As of March 2000, only four of the top 25 most popular websites were non-commercial, and most popular sites are tied to commercial products or television (Montgomery, 2000). As additional developers seek to reach kids with educational games, getting children to the sites will be of key importance. A better understanding of how kids choose their sites will help developers place and market sites appropriately.

Finally, this study used participants with high-speed Internet access, resulting in participants from middle to upper class homes. Additional research could address the success of the program with diverse populations. This research could be especially meaningful once the site has been translated into Spanish and children can use the site in their native language.

Game Play Preferences

Existing research on game play preferences for children is limited. This lack is exacerbated by the changing nature of gaming and the gradually evolving gaming knowledge of children. Analysis of existing games with case studies of what has succeeded can inform designers wishing to advance the field.

Participants acknowledged a difference between games and educational games. More research needs to be done in bridging this gap to create games that do not feel educational.

Process

Druin (1999) established several recommendations for assessing children's behavior in computer interaction. While some of these guidelines were used in this study, other methods also proved successful. Should game players be assessed while in a controlled lab setting, where their behavior could be observed and not interfered with? In what ways does game play differ when a participant is asked to play a game, rather than given the opportunity to play any game? What methods can be used to observe valid behaviors of children while they game?

Summary

Malone initiated a field of inquiry with his research in educational games and also established key guidelines in use today. As the field of research has matured, his original recommendations of including curiosity, challenge, and fantasy have evolved into specific guidelines for game design regarding individualized interests, interface and usability recommendations, and models of what works in educational gaming. While additional research can lead to better evaluation methods, stronger guidelines for development, and additional studies of best-case development, the question "What makes a game fun?" may never be definitively answered. Technology will continue to grow, enhancing our expectations for what a game can and should do; users will change as well, altering their conceptions of when a game is "educational" or when it is "simply fun." What will likely not change is the importance of reflecting on existing research in the field and involving potential game users in the design of learning environments.

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APPENDIX A: PRE- AND POST-TEST

Washing Your Hands
Sometimes it is important to wash your hands. Other times you can wash your hands, *but it's really not needed*. Please note only the times when it is important to wash your hands.

	Wash 'em
Before going to the bathroom	☐
After going to the bathroom	☒
Before watching television	☐
After watching television	☐
Before making a snack or drink	☒
After making a snack or drink	☐
Before playing with a dog or pet	☐
After playing with a dog or pet	☒
Before doing your homework	☐
After doing your homework	☐
Before feeding your baby sister	☒
After feeding your baby sister	☐
Before playing basketball outside	☐
After playing basketball outside.	☒

Washing Your Hands
How long should you wash your hands for? (check one)

☐ ..... At least 5 seconds
☐ ..... At least 10 seconds
☒ ..... At least 20 seconds
☐ ..... At least 1 minute
☐ ..... Only as long as it takes to get them to be completely wet.

Putting Leftovers Away
You've eaten a pizza with your family, and there are leftovers. If you want those leftovers to be safe to eat the next day, how long can they be left out before putting them in the fridge?

☐ ..... No longer than 30 minutes
☐ ..... No longer than 1 hour
☒ ..... No longer than 2 hours
☐ ..... No longer than 4 hours

Killing Bacteria
Bacteria lives on food we eat, and sometimes on our hands or other things. List 2 ways you can kill bacteria.

1. _____[washing]_____
2. _____[cooking or heat] _____

Chilling Food
Why keep food cold in the fridge or freezer? What does it do to bacteria?

[slows growth]

APPENDIX B: ANNOTATED TRANSCRIPT

This annotated transcript for the interview with Grace includes the transcript of the interview, observation notes, comments from peer reviewers, results of pre- and post-tests, and correspondence with parent.

"Grace" 5 of 5 Interviews

Age: 10 (11 next month)

Grade: 5th

Other: not a little girl anymore

View on site: Liked it, though not hugely enthusiastic, played *everything*.

Methodology Log: Pre Visit

I do not know Grace or her family. I got Grace as a subject by sending an email to a local technology group. Asking those who had high speed Internet access and children between the ages of 8 - 12 to contact me if they were interested in the study. And Grace's father contacted me. He actually contacted me about a month ago and we've been going back and forth, having to change times and so forth. So even though she's the last of my 5 subjects, she was actually one of the first that I was trying to get hold of. I'm near her house. And she's in a fairly wealthy subdivision, in city. So I'm assuming as well, that they're an upper-class family. I believe she's an only child, though I'll have to check on that. And I know her father is certainly very technologically savvy, although I do not know about any others in the household. Something that may have an impact is we were going to meet at 3:30 after Grace got out of school, and then we changed it because she had choir practice until 4:30 and also since tomorrow is Halloween. I know that today is a very busy day as she prepares for that. So, I'm wondering if I'm really going to get a look at leisure time experience for her, or if it will feel rushed. She's 8, or 9, she's had a very long day, and now she's going to have to sit down and use this website. So, it might be a good example of what happens when kids kind of sit down to unwind after school. I do not know if this is the time of day when she normally uses the web, or plays computer games. We'll have to see.

Opening – Establishing Rapport

Immediately, Grace does not feel to me like a little girl. Conversation starts with a discussion of Halloween, which she is "just not into this year". The little kids at school do it, but she feels to me like she is just at the age when she does not think of herself as a child anymore, and wants to rebel against things (like Halloween) that kids do.

Q: Are you going to dress up for school?

GRACE: Oh, we already had our party. But, you can bring in your costumes if you want to for the little parade where everyone in the lower grades, in 3rd grade, kindergarten through 3rd grade parades around the school. It's so much fun. Well, the little kids, the 2nd graders and stuff, 2nd and kindergarten come parading through all the classrooms. And the 3rd graders just go parading around.

Q: It's fun to see the little kids dressed up… – So what grade are you in now?

GRACE: 5th.

Q: 5th grade! Uh huh! What school do you go to?

GRACE: Murray.

Q: Where's that at? Obviously around here, probably.

GRACE: Yes. Down, you know where the Ivy starts the…

Q: Okay.

GRACE: It's around there somewhere. Down Morgantown Road just off of 250.

Q: All right. How do you like 5th grade?

GRACE: It's fun.

Q: Really? Is it more fun than 4th grade?

GRACE: Well, I had a really nice teacher for 4th grade. I like my teacher this year but it's just my sister had her for 5th grade, and she's really nice and stuff. My teacher right now, Mr. Myers, he's really nice. His son's in our class.

Q: Oh, is he really?

GRACE: Cause he has 2 sons. One of them's now in 6th grade and last year he was in the other class. And Mr. Myers didn't like the way that turned out. So, this year –

Q: So now, he's got him. Aha! Wow! Well, cool. How do you like being 11? Better than being 10?

GRACE: I don't know, I'm not 11 yet.

Q: Wait a minute! Didn't you tell me you were 11? Oh, almost 11. Next month.

GRACE: Next Friday.

Q: Next Friday! Wow, that's close. Are you going to have a big party?

GRACE: Well, I'm going to have a family birthday party. And I'm going to get my ears pierced. With my friend.

Q: Cool!

GRACE: Well, see her little sister got her ears pierced but she was too afraid to do it. Her little sister's just a wild thing. Anyway, she like chases all the 5th grade guys and it's so cool. Anyway and so she was going to wait until I got my ears pierced to get hers.

Q: Oh, that'll be fun, to do that together. So maybe your parents will give you some earrings for your birthday.

GRACE: Yeah.

Computer Experience and Game Preferences

Summary of Section: Grace is familiar with a computer and uses it regularly to play games, do instant messaging and return to her bookmarked website. She usually uses the computer after school or after dinner, by herself. In her idea of a "fun" game, she included challenge (like multi-levels), feedback (coins or stars marking progress) and diversity of game play. She likes both long-term games (like keeping her cyber pets alive) and short-term, play now or later games (like Pac Man).

Q: Very cool. That sounds awesome. So tell me a little bit — I'm going to move this tape recorder a little bit so I can make sure I hear what you're saying— tell me a little bit about what you do on the computer. When you come in, do you ever come in after school and work on the computer?

GRACE: Yeah, usually. If my parents don't make me immediately go do my homework.

Q: Oh, what kind of things do you like to do? If you have total free time, what do you like to do?

GRACE: I like to talk on my AIM screening. And I'll play spider solitaire a lot.

AIM is instant messenger.

Q: Oh wow.

GRACE: It's my favorite computer game. Not on the internet. And then, if I do go on the internet I've already got my internet set up, so I'll go right to it. Neo-pets.

Q: Neo-pets, that's your favorite site?

GRACE: Yeah. It's a virtual pet site.

Q: Cool.

GRACE: So. That's fun. There's like games and it's just like a little virtual world because you have to keep your pets. They're strange pets, but, you have to keep your pets, see right now they're like really hungry because I haven't fed them in awhile. You'll go around and you feed them and you play games to earn, what's called neo-points, which is money. And use that money to buy stuff and cool site.

Q: Cool. How'd you find out about that site?

GRACE: My friend.

Q: Yeah. Is that how you find out about most of the sites you go to?

GRACE: Ummm….. yeah

Q: Are there any other ways that you learn about sites?

GRACE: Well, I have, we do this thing in school called a weather journal. And it's for a science unit and you have to go the URL and look up weather and stuff. And so I've got two weather sites that I go to. One of them is weather.com and one of them's weather underground. I don't know the exact location of that, but –

Q: So what kind of games do you play? Other than solitaire, do you play any games?

GRACE: Yes.

Q: What kind of games do you like?

GRACE: It's one of them on Neo-pets, it's called America Chase.

Q: America Chase?

GRACE: Merica.

Q: Merica. Okay.

GRACE: And, what you do is, you've got your little guy in there, or little bead things are called negs and they have little smiley faces and they're different colors cause they're worth different points. And you use the keys to direct your guy around and you collect them. And if you run into a wall, then, you die and you have to start again. And if you run into a little red bead appears. That's a fun game.

Q: What do you think makes that game fun?

GRACE: Well, it's probably about the best game on that site. I don't know really what makes it fun. It's like because you got to, like the first time I played I'm always, I kept looking up and down from my keys to the screen. But now I like know the keys and like where they are so I can just move around really well.

Q: Okay, so what's your best friend's name?

GRACE: I have two.

Q: Okay.

GRACE: Three.

Q: Okay.

GRACE: Abbey, Avery, and Darelia.

Q: Okay. So let's say, you know it's like a week from now. It's in the future and you're talking to Abbey, Avery and Darelia. And you, let's just imagine that you had just gone to the coolest website ever, and it's like the best game ever, and you're telling your friends about it. So, imagine... What would that game look like? And what would you tell them about it? What would the graphics be? How would it feel? What would it sound like? Tell me about that.

GRACE: It would be a multi-level game. Well I don't have this game, but when I go to my friend's house I love to play. It's called PacMan. That's a really fun game. I love that game. And so, my ideal game would be a multi-level game like PacMan. And you would go around and you would collect stuff. And you would have if off to the side courses there would be one main game and then, if you, you know hit a certain spot or every time a certain amount of players went then you would play a little off to the side mini-game. And which would earn you points and at the end the person with the most points, or the person who had the most mini-game score records, and the person who had, you know, the most stuff happen to them would get a little star. And then there would be the superstar for the person who had, you know, the main prize, for the person who got the most of everything. Like the most coins.

Q: Cool! So, it sounds like you like games that you can sit down and play. And then you get completely into that set. Like PacMan. But you also like games that you can sit kind of like the animals, and come back to every week and kind of just play them for awhile. Like Neo-pets?

GRACE: Umhmm

Okay. If you were given two hours of free time and your dad says, Grace, you can do whatever you want. You can work on the computer. You can go outside. What are you going to be likely to do?

GRACE: If I had like two hours I'd probably spend about an hour on the computer talking to my friends.

Q: At AIM?

GRACE: Yeah. And just playing games and stuff. And then the second I would probably go outside and practice my gymnastics.

Q: Oh cool. Do you ever work with anyone else on the computer? Is your dad, or your sister in here working on it. Or do you usually just get on it yourself?

GRACE: No, it 's usually just myself.

Q: Cool. Do you play any games on cd or is it mostly internet games?

GRACE: Mostly internet games.

Pre-Test and Food Safety Experience

Summary of Section: Grace seems to have a knowledge of what is "sanitary." She says you don't have to *wash hands after going to the bathroom, but it is just sanitary. Similarly, there is no need to wash hands before making a drink, just before a snack. She answered the two hour rule and 20 second handwashing correctly, through reasoning on her own. She knew anti-bacterial Purell (in place in all the schools in lieu of water due to a severe water shortage) killed bacteria, and washing food, but didn't mention cooking. She felt refrigeration kept bacteria off of food by shielding it from bacteria, rather than by slowing bacterial growth. She helps in kitchen occasionally, clearing dishes, making her own snacks, making salads, and other food prep.*

Q: Oh, all right. Okay. What I have to do, I have some questions I want to ask you a little bit about safety. And, again, it, it's I'm going to ask you the questions when we're all done too.

GRACE: Okay.

Q: Okay. So, here are the questions. Sometimes, it's important to wash your hands. Sometimes, let me start over. Scratch that one and start over again. Sometimes, it's important to wash your hands and sometimes you can wash your hands but it's not really necessary. So I'm going to give you some examples and I want you to tell me when it's really important to wash your hands or when it's really not needed. Does that make sense? All right. Before going to the bathroom?

GRACE: No, you don't need to wash your hands before you go to the bathroom.

Q: Okay, how about after?

GRACE: You don't really have to but it's just sanitary?

Q: Okay, how about before watching television?

GRACE: No.

Q: Okay, how about after watching television?

GRACE: No.

Q: How about before making a snack or a drink?

GRACE: Not a drink, but maybe a snack.

Q: Okay, how about after making a snack?

GRACE: If you use something like, you know, honey and got something all over your hands.

Q: Okay. What's your dog's name?

GRACE: Hawkeye.

Q: Hawkeye's his name. Okay, how about before playing with the dog?

GRACE: No.

Q: How about after?

GRACE: Well, his favorite toy is his tennis ball. It gets all spitty and usually it's really nasty, but, so I guess there'd be a need to do so.

Q: Okay, how about before doing your homework?

GRACE: No.

Q: How about after doing your homework?

GRACE: No.

Q: I know you don't have a baby sister. But, imagine that you did have a baby, who was really a baby. Would you before feeding them?

GRACE: Yes.

Q: Okay. How about after?

GRACE: Yes.

Q: Before playing basketball outside or doing gymnastics or something?

GRACE: No.

Q: How about after?

GRACE: Yes, usually, cause now it's really muddy and I usually get my hands all muddy.

Q: Oh, cause you're dirty. Okay, so I'm going to give you some options. How long should you wash your hands for? At least 5 seconds, at least 10 seconds, at least 20 seconds, at least one minute, or only as long as it takes to get them completely wet?

GRACE: Probably about 20 seconds.

Q: About 20 seconds? How come? What makes you think that?

GRACE: Because it only takes you a couple seconds to get your hands wet, and then you basically, like we have liquid soap, so, rub it in, just wash it off and it shouldn't take more than 20 seconds.

Q: Okay. You've eating pizza with your family, and there's leftovers. You want to eat the leftovers the next day and you want them to be safe. I'm going to give you some options. How long do you think they can be left out before you can put them in the fridge and they'll still be safe the next day? No longer than 30 minutes, no longer than 1 hour, no longer than 2 hours, no longer than 4 hours?

GRACE: Probably no longer than 2 hours.

Q: Okay. What makes you say that?

GRACE: Because like pizza, the example's pizza. If it's in its box, that box usually keeps it sanitary and it usually keeps it from rotting or anything. Like if you had a cut open cantaloupe, you

wouldn't leave it out for more than 2 hours cause it would get all rotten. Same with like a half eaten apple or something.

Q: Okay. Bacteria lives on food that we eat. And, sometimes on our hands and other things. Can you name two ways you can kill bacteria?

GRACE: Well, at school we've got this really nasty smelling stuff and it's antibacterial hand soap.

Q: Okay, can you think of any other ways to kill bacteria?

GRACE: If you're going to eat something that probably has bacteria on it, you can wash it before you eat it.

Q: Okay. Why do we keep food in the refrigerator or the freezer? What does it do to bacteria?

GRACE: It prevents it from like collecting and if it's out it can collect a lot of bacteria because it's getting a lot more of the air, and bacteria in the air and stuff. And, if it's in the fridge it's cool and concealed.

Q: All righty. Do you do a lot of work in the kitchen?

GRACE: I usually make my after school snack which is soup. It's really good

Q: What kind of soup do you make?

GRACE: Ramen.

Q: Ramen soup, I love Ramen soup.

GRACE: I only eat one kind.

Q: Ah, what kind do you like?

GRACE: Chicken Ramen.

Q: You know what's really good?

GRACE: What?

Q: You take the noodles before they're cooked and you break them up. And then, you roast them in the oven with a little bit of butter and garlic, and they're like really crunchy. Okay. Do you help clean up the dishes after supper? Or, clear the table or put leftovers away?

GRACE: If I don't have tons of homework, yes.

Q: Yes, if not you can go do your homework?

GRACE: Yes.

Q: How about do you help your mom and your dad cook supper?

GRACE: Sometimes.

Q: What kind of things do you do?

GRACE: I'll, if they have just like some work to do and they've got water about to boil on the stove, I'll watch it. And then, call them when it boils.

Q: Do you ever do anything like help make the salad? Or cut up vegetables?

GRACE: Yes, I help cut up vegetables, I spin the lettuce. It's fun. And we have this thing, Pillsbury Crescent Rolls. We usually make those.

Q: I'm sorry, when you have time, when you don't have homework, you can help like clear the table. Do you ever put the food away? Or, do you wash dishes? Or what's your job?

GRACE: Well, sometimes, if, like I said, if my parents have a lot of work, me and Mark will be left to do the dishes. And, one of us will wash and one of us will dry.

Q: Ah ha. That's what me and my sister always used to do.

GRACE: And sometimes, if Margaret has a lot of homework, like she usually does, she's in 8th grade, she, I'll be clearing the table and my parents will be washing and stuff.

Beginning of Website

Summary of Section: She moves through beginning features with ease, not turning on the speakers until half way through the trailer. She likes the trailer and says it is 'action packed'. She reads all the instructions on screen.

Q: Cool. Are you ready to take a look at this website?

GRACE: Okay.

Q: You want me to give you the URL for it?

GRACE: Okay.

Q: It's www.fooddetectives.com.

GRACE: Okay.

She types the URL in no problem… I simply say it and she types it in. She comes to the main screen and rolls over the food detectives logo on the left with her mouse, also reading the text in the web page.

Q: Something I'd like you to do for me Grace, it's called talking aloud. What that means is, I can't really guess what you're thinking, cause, well, can you read minds?

GRACE: Sometimes.

Q: Yes? I'm awful at it. I can't do it at all. So what helps me is if you say things like, talking aloud means you're talking and kind of telling me what you are thinking. So you might say something like, "well, I'm looking for this button, but I can't see where I'm going. Oh, now I see where it is. Now I'm going to click this button cause it looks like it's something fun to do.

So, as much as you can just talk about those things outloud to help me.

GRACE: Okay.

Q: Awesome. As you were! And you can also tell me what you think. Whether things are cool, or weird or whatever.

She starts the trailer… but sound turned on until part way through. She thinks the intro is interesting. She is smiling… says it is action packed and that she likes it.

Q: I don't think your sounds turned on do you?

GRACE: Oh. (Sound gets turned on.) This is an interesting intro.

Q: What do you think about it?

GRACE: It's interesting. It's like action packed.

Q: You like that?

GRACE: Yes.

She comes to the introductions. She reads them patiently. I have a great view… here, I can see her face, and the computer screen at the same time… which is good, she is talkative, but I think she may be more subdued while playing, and her face will be a greater indication of her feelings.

GRACE: I can't decide which buttons do I use. Do I use the keys or the mouse?

Q: Well, tell you what. I'm going to try to be quiet, and we'll see if you can tell me about it after awhile.

Case of the Kid Who Knew Enough (Sticker maker)

Summary of Section: She moves easily through the interface. At the beginning of this session, I tell her to move through the entire site and do whatever she wants, telling me when she is finished. She likes the stickers, giving specific reasons for each artistic choice. She cares about making them "match", getting graphics that match the word blurb, and backgrounds that match the border. She prints the stickers, and says she likes her stickers and the game, because it lets her be artistic – something she doesn't feel she is off of the computer.

GRACE: Okay.

I'm going to try the "Kid Who Knew Enough" because (pause) just because. Because it sounds interesting.

Q: Okay.

She reads the directions, clicking right through after reading. She is anxious to get started, and rolls cursor over the tabs in the introduction, though they are not active, they are just there to demonstrate what to do. She reviews the text after trying to roll over the tabs and clicks "Let's go." She jumps right into the tabs, selecting things, no problem. She talks me through her choices. She begins with a border of bubbles. She has this talk aloud thing down…!

GRACE: Um. So, okay. I like this because it's bubbles and it reminds me of Spongebob.

Q: Oh, you're like a Spongebob's Square Pants fan.

GRACE: I'll pick blue because it reminds me of my sister's room. A lot of the stuff in there is blue and also, it contrasts with the light blue of the bubbles. Here, I picked do you wash them, because the bubbles, remind me of soap, so I'm thinking soap. I picked the sink because it's do you wash them, and washing them consists of a sink and soap. And then the hands because it is showing you washing.

She clicks a couple of different word blurbs, reading them. She intuitively grabs the text to move it, I don't think she had to read the sentence that explains that. She seems to want her choices to "match" each other. She takes time to build the stickers, moving the graphics so the text can be read, with the graphics. She picks the "do you wash 'em" blurb.

GRACE: Can I decorate more than one?

Q: You do whatever you want. In fact the whole site, you just play as much as you want and when you're all done, you tell me you're all done.

GRACE: All right. I chose this because it, the orange and green reminds me of like something sickly. Like bacteria and stuff.

As she grabs BAC to put on the orange and green blobby sticker, she laughs a bit to herself. She in putting her necklace in her mouth, perhaps a nervous habit, but is very engaged in the game, putting thought into which picture to put on the sticker that is "sickly looking."

GRACE: Um. I chose the refrigerator and the bacteria because one of the main things I think about when I think of bacteria is non-

chilled food. Because sometimes things turn really nasty when you leave them out. I chose this background because it's really cool. I like that it makes it sickly green. It kind of looks like the green look like it's darker back here, but then it's brighter like it's got a sunspot. And it reminds me of something it wouldn't go really well for the word blurb right here. Cause it's like popping out at you. Like the screen was normally orange, but then the screen thing just pops out at you to say something.

As she is talking aloud, I wonder if she is having to think about what she is doing, when maybe she would be a little more absent minded about it. She relates the green to a sun spot. Man… she knows a lot for an almost-eleven year old.

GRACE: Okay. I chose the police guy, the police guy and the paper towel because this guy seems more, seems to me more like more of a bacteria stopper because paper towels are used a lot to get things off the tables, and stuff, and clean stuff. And I chose this man cause he's kind of like the BAC stoppers and I like stopping crime.

She picks the badge, then changes it to a police man… she is having no problem with the interface, she is making the stickers as she likes them. As she moves to the fourth sticker and picks the paper towel, she says "Cool"… picking borders that she has not used.

She is very methodical in how she is putting her stuff together. She reads the text outloud, "Two hours is the limit." She repeats it in a very movie-trailer, official sounding voice. She is looking for pictures that "match" the text.

GRACE: I chose this border and this background because they're the only two ones I haven't used. And I like this cause it's cool. It's like a long chain of paper towels. Word blurbs. Tips. I chose that because it's, I think that's a cool word blurb. "Two hours is the limit."

I chose this picture of a fruit because it's food and it says, you know, get food in the fridge.

I'm going to change this around. I want to change my detectives. I want this guy, cause it's going to cook something. You've got to cook it.

This is cool.

Her computer is well stocked… there is an Intel digital camera on top, a digital printer, speakers.

Now that her stickers are done, she is going back and making changes, making them match. She prints right away, saying the stickers are cool.

GRACE: I really like my stickers. Cause one of my favorite subjects is art, and so, I like doing on the computer. Because I'm not that artistic with my hands, so the alternative is the computer. And I like doing that because, with, when you're just doing it by hand you don't have like all these cool picks that, like if you're doing

stamps or something by hand, you can only have one color unless you take a marker and color in to a piece. And you can do it easy just by the click of a mouse and you can have all fun, cool designs. And it's just cool.

Q: What kind of programs do you like to use to make ----.

GRACE: At school I like to use Kid Pics Studio, and here, since we don't have Kid Pics Studio I like well, Paint, which is on the start menu.

After printing, the screen has to be clicked anywhere in the screen to prompt the game out of printing mode and give her back her menus. She doesn't click, instead waiting for a prompt. After waiting a few seconds, she hits the browser's back button, which returns her to the sticker introductions. She skips through the intro, saying "I already did this." She exits back to the main screen.

The Case of the Filthy Fingers (Hand washing Timeline)

Summary of Section: She plays this game 4 times, reviewing the instructions again between the 2nd and the 3rd time. She had some difficulty understanding the timeline concept, and understanding she needed to look at both what she just did, and what she was about to do. She played until she realized the one she kept getting wrong was that she should wash her hands before making a drink. Once she realized this, she played again, answering that one correctly, and solved the case. She said it was a fun game, and educational, noting what she had learned about washing before making a drink.

She reads the intro, and realizes one of the graphics on one of the handwashing incidents was one she used on her stickers.

She reads the directions and asks if about if she should wash or not… I stay silent.

GRACE: I'm going to pull a Filthy Fingered one cause it, it's sort of a rough one. And now I know what kind of stuff there is and it's, now I'm just going to go through the rest of them.

I know that picture, that's the one I used on one of my stickers (she reads the directions softly to herself)

So I have to decide if you should wash your hands or not? Oh!

The game begins, with the first option. She has to decide if she should wash her hands before making a drink. She doesn't understand the timeline at first, and asks,

GRACE: So, is this before or after?

Q: You have to tell me.

GRACE: It's probably after.

She says you don't have to wash before making a drink and moves through the game, mumbling to her self ("Washing before… hmm, no you don't need to") as she moves through the activities,

putting thought into each one. Again, in the middle of the timeline, she gets stumped on if something is before or after. She gets 3 wrong.

She doesn't notice the timer is ticking, and hits plunger… saying "okay" but not doing anything, for a few seconds, then starts to change one of her answers. She runs out of time and says "Oh no"… immediately playing again.

On her second game time, she says to wash before but not after going to bathroom, and not before making a drink. Again, she misses 3. She says, "hmmm…". And goes through making one changes. She hits the browser "back" button, which puts her into the instructions again.

On the first screen, she says, "Oh, I get it!" and quickly goes through the rest of the introduction text.

This time through she says she doesn't need to wash before a drink. She moves through the others, looking at what she is about to do, not what she just did (Still an important part of the game). She rolls her cursor over them.

GRACE: I still seem to be getting one wrong. I know you don't need, well, you might need to wash your hands when you make a drink. That might be what I'm getting wrong. Cause I know you don't have to wash your hands just to watch TV. I know because I have a baby cousin that you should always wash your hands before you eat. To do homework you don't need to wash your hands because all you're doing is touching a pencil. And, yes. No, you don't need to. To eat a sandwich, yes. To play with your dog, no, you don't need to. Before going to bathroom, no. Help prepare supper, yes, you should. If you watch TV, no.

She runs out of time and plays again. This time, she tries saying yes before making a drink. She gets them all right and solves the case. She seems to like it.

Q: What'd you think of that one?

GRACE: That was interesting. Cause you, it was kind of like an educational game, cause you found out if you really do need to wash your hands or not. Cause, I personally thought that you didn't need to wash your hands to make a drink, but I'll think about it that there are more drinks that you should wash your hands before you drink. Like if you are just going to drink something out of a bottle or something, you don't really need to wash your hands, cause you're just going to touch the bottle. But if you're going to make a milkshake or something you're going to use your hands, so you should.

The Case of the BAC that Kept Growing (Shooting Game)

Summary of Section: Grace likes this game better — she says— than the handwashing game. She reads directions, but still has questions about how to shoot and use the ice cube, figuring it out as she goes a long. She plays one game, but gets to several levels.

She goes through the instructions and smiles when BAC gets shot in the instructions. She says it is “cool” before she is even done reading the instructions.

GRACE: Awesome. This looks like a cool game cause you either shoot fire or shoot bubbles. Okay.

The game begins… she starts clicking the mouse and firing.

GRACE: So, do you use your keys? And how do I shoot? How do I shoot with the bubbles?

Q: I can't tell you. I'm here to just watch.

She starts shooting a BAC… without. She happens to hit a soap pump, then says:

GRACE: Okay. Oh, I get it. You have to shoot one of the soap bottles or ovens to get that power… So this one I can't get the ice cause I have bubbles... Maybe I can, awesome!

As she plays, she talks to herself, and discovers she can shoot the ice cube. She gets 8 of 10 and goes on to round two. She talks (to herself and to me) throughout game play.

GRACE: I think the bubbles are more effective. I don't know why, I just do.

She is shooting, one shot per character, trying to get soap when it goes by. She likes the bubbles. She gets 9 of 10. Round 4. She makes judgments about which ‘kill’ better.

GRACE: I definitely like the bubbles more than the flames because they seem to kill more effectively. With the bubbles I can get 90% of the, well these.

This game is interesting, it reminds me of one of the games that I used to play when I was… except that it's a little bit harder. In the game that I played when I was little the characters moved a lot slower, so they were easier to get and that made it easier.

And I've noticed that when you move up into the higher levels there are more chances to get either the flames or the soap. And one of the things with this game is I've noticed with the bubbles they cover a wider range. And so, I like that better. And there's a game sort of like this and there are waves of the things instead of just single ones running across.

Now, she doesn’t even stop to see how she does at the end of each round, she immediately clicks “continue” to move into the next round. She says she likes it. She like this game better than the handwashing game.

GRACE: This is an interesting game. I like it better than I like the one where you have to guess whether you should wash it or not.

She gets 5 of 10 in this round and plays again. She is missing some BAC now, especially when she cannot hit the soap. She is starting to click more frequently. She accidentally gets an oven and says, “darn.” She loses her game, and goes to the main screen, clicking the food gone bad.

Case of the Food Gone Bad (Concentration)

Summary of section: she plays the game, reading the ending background blurb, but talking to me and not reading any of the information blurbs… including the jokes.

GRACE: Food gone bad, that looks interesting. “Food gone bad”

As she reads the title the second time, she does so in a funny, “Movie announcer” voice. Her first match is a simple sentence, she reads it and clicks “ok”. She is pretty bad at matching, perhaps because she is distracted by me. When she makes a match and the blurb comes up, she starts talking to me, and immediately clicking “ok”. She gets a joke and doesn’t even notice. She keeps talking to me, and clicking “ok”. She reads the ‘meet the detectives’ background, kind of mumbling to herself. She has completed the in 30 tries and pauses a minute over “play again”, but then exits.

GRACE: This game is like a memory game. I used to have a really good memory when I used to play a memory game sort of like this except it was with famous paintings. And I have a really good memory when I play that. I used to just flip over the cards and I would just, if one card got flipped over and then its match got flipped over once, it's like completely different times I always seemed to know where it was.

That's cool.

Meet the detectives. (she reads the background to herself, mumbling) .

Discussion of the Games

Summary of Section: BAC TV and certificates are not compatible with Windows XP, the operating system on her computer. We talk about the program. She says she would recommend it to her friends, who would probably like it. She thinks it is for kids her age and younger. I use my laptop and open it for her so she can play BAC TV and the certificate.

Grace clicks on the credits and reads them, finding my name and says “There’s your name!” She now obviously knows I created the game. (Lara: How do you think this affected her review of it?)

Grace has discovered a bug in the program. On her version of Explorer (Windows XP… a newer operating system that has come out in the 6 months the Food Detectives has been on line), neither the BACTV or the certificate work. I decide to just take the time to discuss the other games.

GRACE: Oh look, bacteria. BAC TV. I can’ get to the make the certificate or BAC TV.

Q: What do you think? How do you know if it's, everything's kind of stopping there doesn't it? Well, tell me about the other one.

GRACE: They were full. I like them. They were like the other games that you could play at school, and have connected to school websites. And, cause they're always telling us to wash our hands before we go to lunch. And when you're in kindergarten they make you line up and wash your hands.

Q: Oh, okay.

GRACE: After school before you eat snack, you have to wash your hands, otherwise, well they'll make you go back if you haven't washed your hands.

Q: Would you recommend this site to Abbey or...

GRACE: Avery.

Q: Thank you. Or Avery or...

GRACE: Darelia.

Q: Darelia.

GRACE: Yeah, they've all got hard names. Yeah.

Q: Yeah? How come? Do you think they'd enjoy it or do you think that they should learn something?

GRACE: I think they'd enjoy it. Darelia has her own website and she could make a link to this because her brother would probably really like this.

Q: Oh, okay. How old is her brother?

GRACE: I'm not sure.

Q: Who do you think this website's perfect audience is? Who do you think it should be made for?

GRACE: Probably in the range of, I don't really know.

Q: Do you think it's for kids your age? Or for kids younger, older?

GRACE: Probably about a little younger than me and probably about my age. My age and younger.

Q: If your dad would say, “now here's a website and I want you to go to it. “ Would you play all of it like you did today? Or, would you play some of it and come back tomorrow?

GRACE: I don't know.

Q: Let's try and see if we can get those two to work. I don't know why it stopped. Do you have a reload button you can press?

GRACE: I don't know, I don't think so.

Q: You have a browser that I'm not familiar with. Try clicking it again and see what it does. Click the, see the piece of paper with the two green arrows on it up by the house and the toolbox? Click that. I'd like you to see those two sections and I'm sorry they're not working.

GRACE: That's all right. It's probably just my computer.

Q: Do you always use Internet Explorer? Do you ever use Netscape?

GRACE: No. I always use Internet Explorer

Q: Do you know what system you all have? What operating system? Do you use Windows?

GRACE: It's Windows XP.

Q: Yeah, that'll do it. I wonder if there's something weird in the browser that it can't read it. Let's see if I can bring it up on my computer. Would you want to work on it here if I can bring it up?

GRACE: Sure.

Q: And you can tell me about it later. You like that?

GRACE: Yeah.

Q: Now I have to remember where I put it.

I pull out my laptop, and open the game to work directly from my hard drive. My laptop is a Macintosh, so it may feel differently to her. I also have a track pad, not a mouse. I hear in the kitchen her mom and sister have come back and the rest of the family is all talking in the kitchen.

Q: Do you know how to use one of these track pads?

GRACE: Yeah.

Q: Oh, excellent. Do you use these at school?

GRACE: Yes. Well, sometimes. Last year we had like 30 kids in our class. So we didn't have enough computers.

As the program starts again, the intro plays again.

GRACE:I really like that intro.

She has to click through the introduction to the site again, which she does while skimming the text again.

Q: Yeah? You can play the BAC TV and then we'll make it so you can make some certificates.

BAC TV

Summary of Section: As she listens to songs, she also talks with me. She feels the songs – especially the voice – is a little juvenile, but she likes the videos and picks up on a lot of the animation details. She says when she was little, she liked games that taught her stuff. She reviews some of the games in this website, mentioning that she likes the matching and the shooting game, and the games are more for her age group than the songs. When given a chance to end the session, she reminds me that she wants to do the certificate.

She rolls over the cat twice and hears the sounds, then giggles. She selects the first song, taking her hand off the mouse and engaged. She even notices details, pointing to the picture of the banana and noticing the banana sticker.

GRACE: That was interesting.

Q: Why else do you think about it?

GRACE: Well, that seems like a song that more into, more oriented with kids of a younger age group.

Q: What makes you say that? How do you know?

GRACE: Because I was babysitting this little kid and his older brother at my mom's work. And he had this game called "Freddy Fish" and they had a song sort of similar to that.

Q: Okay.

Grace selects the next song, and smiles at a couple of the things, noticing additional details like the disco ball. (“Disco Baaaalll,” she says)

GRACE: I like the dancing. I like these graphics, the dancing and the little spots moving around. I like the ice cube, I really like the dancing!

She listens through the whole song, and then click the next song to the right in the list. Out of instinct, she grabs the mouse to her computer, thinking it will control the laptop.

GRACE: I'm using this mouse to try to control the mouse on that?

Q: Oh yeah. As if it makes the computer.

GRACE: I like the bubbles. I like that music video, cause it was like stuff coming at you. The song was for like another age group I thought.

Q: Do you think it's because of the person singing it? Or do you think it's the song? Do you think it's the words? What could make it more that you would like it?

GRACE: Right now I'm into like Michele Branch and (indiscernible) Two new female artists. And so I'm into the pop generation, so I like it more. And it's kind of, like one of those songs, like, I know, when I was little I used to really like the games that taught you stuff. When I was like 6 or 7, and so that would, sort of be the kind I really would have liked.

Q: You don't like games now that teach you stuff?

GRACE: Well, I guess.

She starts another song. She plays it all the way through.

GRACE: Now I like heard another song by the same voice. I think it might be the voice. And, I like the music video because it's, it's like, this guy who is like my half brother, cause I've known him ever since I was 3 years old, or 3 months old or something. He is always, he has always been into mass destruction. And so, that just kind of the same, mass destruction. It showed it getting too hot and exploding.

Q: You like that?

GRACE: Yes.

Q: What do you think we could do that would make this, what's good about this website? What do you like about it?

GRACE: I like the games. And… (pause)

Q: When you say you like the games, what do you like about them?

GRACE: I like that, well I like the game where you use that thing and you shoot them. And you get like different tools and stuff, because that seems more like my age kind of games. Because, you know, I've played games like that before and I like them. And so, that was more to my liking.

Q: What do you think about the graphics?

GRACE: I like the graphics. You've gotgood graphics. (Lara: This is one indication that she is responding to 'you' as developer.)

Q: Is it because of the colors? The way they're drawn?

GRACE: I like that they all are sort of realistic but they've still got that animated edge to them. And I like the colors too.

Q: What do you think we should fix? If you were going to say, “hey, friends this is a website you've got to go to, what would we have to do before you would say that?

GRACE: Hmmm.. (pause) I don't know.

Q: Okay, all right. Is there anything else you want to tell me about the site? Or anything else you think I should know about it?

GRACE: It's a cool site.

Q: Okay. Would you recommend it to your friends tomorrow?

GRACE: Yes.

Q: Do you think they'd go home and play it?

GRACE: Yes.

Q: Is there any part of it you'd want to come back to later and play again?

GRACE: I liked the case of the Good Food Gone Bad. I liked that one.

Q: The matching card game.

GRACE: It was the, yes, it was those two, the bacteria that kept growing and good food gone bad.

I assume our session is about over. I realize I may have been leading her earlier in pulling out my computer, and I don’t want her to feel that she has to play all the section. Plus, the dinner her dad is cooking smells really good and finished now.

Q: Okay. Well, I'm going to put my computer back. And I'll ask you one last round of questions.

GRACE: Hold on. Can I get my certificates?

Q: Yeah, let me fix it so you can do that. Cause you haven't solved them all and that just if you've solved them all on the other one. Oh, wait a minute. I know there's a way to do it, I just can't remember it. I'm going to have to go through the other games real quickly.

To make the certificate available on my computer, I need to go through and hit the “solved” point for each game. I rush through the handwashing game to solve that game. I shoot enough BAC in the shooting game to get to round 2, and exit, knowing that will cause that board to be cleared. I quickly open the stickers, hit the “print” button knowing that will cause that game to be solved. She waits patiently watching as I go through the games as quickly as I can. I move quickly to the matching game to match them all: the board has to be cleared to get it to be solved.

Q: Oh, now I've got to match them all.

GRACE: Yeah. I'll do that.

Q: Okay, you want to match them for me?

She clears the board, making the match, but not reading any of them. She clears the board and starts to hit the “play again” button, but remembers the certificate (OH, the certificate) and exits instead.

Certificate

In the certificate, she moves around with no trouble, building a certificate, reading each blurb and selecting each graphic before creating one. She cannot print from my laptop, so once it is finished, she exits.

Q: What do you think of this activities so far?

GRACE: It's fun.

Q: If it were on your computer would you have printed that?

GRACE: Yeah, probably.

Q: Yeah? What would you do with the general certificate?

GRACE: Probably post it on my bulletin board.

Post-Test

Summary of Section: This time, she answers all the handwashing situations correctly, including washing before a drink. She keeps the 20 second rule and 2 hour rule answers correct, this time adding “At the most” to her answer on the 2 hour rule. She knows that cooking, washing and chilling food properly all deter bacteria, and says that chilling bacteria kills it by freezing it up – still not exactly correct, but more correct than shielding it from bacteria by putting it in the fridge… a step up from her pre-test. She comments that she learned the 2 hour rule, and that not cooking to a proper temperature will make you sick.

Q: Good. All right. Well, I'll take that and I'll ask you some more questions and you can go get some of that great dinner your Dad's fixed. Smells wonderful. Smells like curry.

GRACE: I don't like it.

Q: You don't like curry? Well, that's a problem, if you don't like curry. Cause once you make curry the smell stays in the house for a couple of days, doesn't it?

GRACE: Yeah.

Q: It's great if you like curry, but it's not so great if you don't like curry. Okay, I'm going to just ask you some questions that we went through earlier.

GRACE: Okay.

Q: And we'll be all done. Okay, sometimes it's important to wash your hands. Other times you can but it's really not needed. Tell me when it is and when it . Before going to the bathroom?

GRACE: No.

Q: After going to the bathroom?

GRACE: Yes.

Q: Which, was that a yes?

GRACE: Yes.

Q: Oh, okay. Before watching television?

GRACE: No.

Q: After watching television?

GRACE: No.

Q: Okay. Before making a snack or a drink?

GRACE: Yes.

Q: After making a snack or a drink?

GRACE: Yes.

Q: Before playing with a dog or a pet?

GRACE: No.

Q: After playing with a dog or a pet?

GRACE: Yes, sometimes.

Q: Before doing your homework?

GRACE: No.

Q: After doing your homework?

GRACE: No.

Q: Before feeding your baby sister?

GRACE: Yes.

Q: After feeding your baby sister? I know you don't actually have a baby sister.

GRACE: Yes.

Q: Before playing outside?

GRACE: No.

Q: After playing outside?

GRACE: Sometimes.

Q: Okay. How long should you wash your hands for? 5

GRACE: 20 seconds.

Q: How come?

GRACE: Because it takes a couple seconds to get them wet, a couple of seconds to get them soapy, and then a couple of seconds to wash them.

Q: Okay. Putting leftovers away. You've eaten a pizza with your family, how long can they be out? 30 minutes, 1 hour, 2 hours, or 4 hours?

GRACE: 2 hours.

Q: Okay.

GRACE: At the most.

Q: Okay. Bacteria lives on food we eat, sometimes on our hands. Can you name two ways to kill bacteria?

GRACE: Cook food and chill food properly and wash your hands.

Q: How'd you know all that?

GRACE: From the site.

Q: From which, do you remember which games?

GRACE: Well, from the music videos.

Q: Okay. Why do we keep food in the fridge or the freezer? What does it do to bacteria?

GRACE: It kills it by freezing it up.

Q: Do you think you learned anything from playing the site?

GRACE: Yes.

Q: What do you think you learned?

GRACE: You know, things can go bad after 2 or more hours. And, that if you don't cook poultry and meat to the correct amount you can get sick.

Q: Would you describe it as an educational site, or a game website?

GRACE: Probably both, educational games.

Q: Grace, you have just been really helpful. I appreciate you taking your time to do this, especially after a long day.

Methodology Log: Post

Okay this is the post follow-up: I have my methodology log, handwritten, I need to take care of that when I get home so I still remember it, since I wasn't typing it in. My handwriting as good as my typing, so I hope I won't miss that. Let me tell you about Grace. She is, I would not say she's shy necessarily, she's kind of reserved. She's not real expressive, or enthusiastic. She was very polite when I came in and told her Dad she had to go to the bathroom. So she had to go to the bathroom and I made small talk with her Dad. We came down, and she was very courteous, and was very respectful to me, and asked what we were going to do.

And I was really glad I had a chance to look at her face, because that's how I could tell that she liked something. When she got this kind of tickled look on her face, or when she was smiling.

She is very computer literate. Her Dad has XP on the Windows, which is one reason I think the games weren't working correctly. The newest system it's working, he said he's very much a techie, even though her mom is not. Julia knew her way around the computer, knew how to open things, close things. She knew which operating system she had. She had no problem when her computer stopped working on the games, going to my laptop which has a track-pad, did not phase her. She said she'd used it before at school, it was no problem at all. She's obviously very comfortable, as she mentioned, if she had spare time she would choose to come in and work on her computer. I think her Dad works out of the house. He is there when Grace gets home from school. He was making curry while we were working and I heard her mom come home, and they were talking in the kitchen.

As we finished Grace was starting to fidget a little bit while I was asking her the post-test questions. She was kind of standing on the chair, with one leg on the chair, kind of fidgeting around. But, she was still very polite to help me. She did the certificate and seemed very happy with that. And I think was ready by the end of our session. I think our session ended right at about 5:45, it's right at 6:00 now, so as I look at the time it gives me an idea of how long she was playing.

One of the things I noticed with Grace, even though she wasn't real bubbly and eager to greet me and, you know, wasn't cheerful, giving me a hug like some of the other kids have, she wasn't that way with her parents either. As I left her mom just quietly put her hand on her back, and asked her how her day was. Grace was very quiet, I didn't hear what she said at all. I mean, she just that expressive of a girl.

But, I was impressed with her maturity of being able to explain things. In the way she could explain what made a game fun, or why she liked a certain artist, or how different things happened, how she did things with her friends. She had a real facility for words, an ability to express things. So when she said that she liked things, or that she enjoyed things, I thought that was very genuine. I did see these slight little smiles creep across her face, and even though I didn't hear her laughing or hear a lot of enthusiasm in what she was saying, I know that she did enjoy it because she was content and happy to just sit and play. That concludes the methodology log.

Email from Father

Grace is above grade level across the board. I attribute this to good genetics, but others may disagree :)

As for the game, as far as I know, Grace has not returned to play the game. I believe that she did have fun working with you although she thought the game was probably suited for younger kids. We had told her before hand to give you honest opinions, so I think she probably did. I have talked to her a couple of times about the game, and she seems to have picked up and retained some of the key points about bacteria. Because the game was educational, she probably would not admit to it being too much fun.

And then later…

My reply seems to have been a bit hasty in one area. Katherine informed me that she had returned to the site a couple of times. Once by herself to play the game, and once at a friend's house to show her.