2009

Learning through gaming: Teaching visual arts to elementary grade students

Ya-lan Yang
Iowa State University

Learning through gaming: Teaching visual arts to elementary grade students

by

Ya-Lan Yang

A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Education (Curriculum and Instructional Technology)

Program of Study Committee:
Ana-Paula Correia, Major Professor
Ann. D Thompson
Paul Bruski

Iowa State University

Ames, Iowa

2009

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

This study aims to investigate the cognitive and affective impact that a Web-based Flash game called "Color in Motion," has on teaching visual arts to elementary grade students. Pretests and posttests, observations, recordings of on-screen game play activity, and interviews were used as the data collection instruments for this study. Pretests and posttests were used to identify if the game had cognitive impact on learners. Observations and recordings of on-screen game play activity were utilized to inform the affective impact of gaming on students' learning. Interviews were to understand the cognitive and affective impact of the Web-based Flash game on students' learning. Six 10-to-12 year old students recruited from a Midwestern after-school club participated in this study. The findings showed students' cognition of basic color attributes did not have notable improvement; however, most students were able to recognize the color symbolism after playing the Web-based Flash game. In addition, most students demonstrated engagement, expression, and exploration well while playing the game, but persistence of the game playing was lacked. Overall, all students were very positive about using the Web-based Flash game to learn the visual arts. Consequently, the findings of this study indicate that games have a promising future in teaching arts for elementary grade students.

CHAPTER 1. INTRODUCTION

After the World Wide Web rapidly spread in the 21st century, the Internet has accumulated more and more arts materials and resources. Arts information can now be easily found on the Internet, whether information about traditional art or new developing artistic cultures. These plentiful arts resources on the Internet are advantageous for teaching and studying arts in schools. Because the Internet brings the information to students whenever they are located and at whatever time, students can visit every large art museum or participate in various arts activities without travel and at convenient times. Therefore, educators and school districts can take advantage of the Internet's characteristics to instruct the new generation and raise awareness about arts in general.

According to Americans for the Arts (2007), a national organization, arts education policy has been accepted by the nation, states, and local districts, so local school districts should help lead the development of arts education. That is, arts have been written into federal law as a main subject in K-12 public schools, and, consequently, public schools play the major role of providing arts curriculum to youth. However, much of the empirical literature has revealed that although the arts are a main subject in schools by law, many school districts still see the arts as a sub-academic subject. Further, most schools do not offer programs and teachers to teach visual arts because they have perceived that the arts are useless and inapplicable to children (Americans for the Arts, 2007).

At the same time, over the past decade, online educational programs have developed at an extraordinary rate. In terms of the NETC (2005), the regional technology consortium, more than 50 percent of all school districts provide some online

courses, and more than 30 percent have created flexible learning environments. Indeed, electronic learning has emerged in education as a means for providing a variety of educational opportunities to a diverse community. That is, online components and face-to-face activities are often combined together to form new learning environments. Therefore, when online components integrate into the traditional academic course, the instructional approaches can be more diverse, fascinating, and practical (Abrahmov & Ronen, 2008). Therefore, research and application of electronic learning has received increasing attention in recent years.

Research suggests that Web-based activities make students more active and creative in the subject areas when the online elements mix different learning styles for different purpose (Abrahmov & Ronen, 2008). Students can engage in their activities and develop the skills that guided by these activities. Much of the literature revealed that electronic learning is increasingly used in higher education. Nevertheless, there are no concrete standards for K-12 online teaching and learning because the effects of online teaching and learning are not yet well understood by educators (NETC, 2005), especially for elementary education.

There is some evidence to suggest that educators and instructional designers can create highly interactive and learner-centered learning environment for students when combining computer games and Web-based learning (Kirkley & Kirkley, 2005). For example, architectural students compare a real plastic model of a city and virtual scene in CAD models of their designs, so they can examine the different building styles in different space. In another example, soldiers participate in a training program that uses video games on a computer with a head-worn display. This head-worn display makes

soldiers interact with virtual characters, transportation, and buildings just like they appear in the real world (Kirkley & Kirkley, 2005). These are two examples of prototype learning system used in higher education. Consequently, games and simulations encourage learning because students absorb the information and patterns during the game playing, and games also produce fun, which Koster (2004) defined as "the feedback the brain gives us when we are absorbing patterns for learning purposes" (p. 96). Students can be motivated and entertained when they are involved in these types of game-based constructivist environments where students create and solve their own problems. Examples are two indications that games could be successfully used in education. However, no literature had been found about research on gaming in arts education. Most other researchers have focused on other academic subjects when applying games in education.

The purpose of this study is to select and critique one Web-based Flash game that can be used to educate elementary grade students. However, previous research has established that each Web-based tool should be carefully chosen for where it could have the best effect (Abrahmov & Ronen, 2008). Thus, game learning can have the greatest effects for elementary school students if appropriate technology skills and learning pedagogies are used.

With those factors in mind, this research attempts to evaluate a Web-based Flash game called "Color in Motion," which can be used for K-6 settings. The research also presents the findings and challenges when "Color in Motion" is used to teach elementary grade students about visual arts. This effort hopefully provides an alternative teaching method and some useful recommendations to school districts and art teachers to advance

game teaching and learning in elementary school. As a result, it is hoped that educators and school districts can take advantage of the Internet to complement the lack of the arts materials and knowledge in schools, especially in small or rural schools.

Literature Search Method

Twenty-two academic journals, 10 books, and six reports from national organization of arts in K-12 settings were reviewed. The journals were selected using two online databases, First Search and ERIC. First Search can classify and provide relevant article results for the researcher when putting the keywords and search within the education field. ERIC is what educators normally used to search the articles, so the researcher used this as the major database. In addition, Google Scholar was used to search the relevant theoretical books and articles, and the researcher used back referencing to find key articles as well. Through these different searching methods, the researcher got some critical and useful articles to write a strong literature review.

The following keywords were used in the search: “online gaming,” “Web-based gaming,” “learning theory,” “motivation” “game theory,” “arts education,” and “visual arts + education.” In order to get the diverse and non-limited results, the researcher also combined these different keywords to search for articles. Since this research explores issues in arts education, the author used several reports and information from two national organizations’ Web sites related to arts and education as sources to support the literature review. A total of 38 articles were reviewed, and a few theoretical articles and books were also included to help understand the relationship between learning and gaming in order to study this new trend in the educational environment.

Literature Review Outline

Since this research examines the effects of implementing a Web-based Flash game in arts education, the target audiences are educators who do not generally have much knowledge about gaming used in education. It also targets school districts and policy makers who will help the next generation absorb advanced knowledge by offering useful and effective instructional technologies. Additionally, this study will also benefit students, teachers, and school staffs who are engaged in using instructional technology in K-6 learning environments. Therefore, this literature review will only describe the K-6 arts learning environment, rather than covering all K-12 settings.

The literature review is divided into four sections. Section one describes current gaming research in educational environments and gaming's benefits for learning and teaching. Section two discusses learning and gaming theory, constructivism learning, game object model, and the motivation and learning objectives included in a game. Section three broadly depicts arts education in the current elementary environment, and it also presents the importance of arts education on students' learning process. Section four concludes with findings for future research.

CHAPTER 2. LITERATURE REVIEW

Current Gaming Research in Education

Research suggests that half of U.S. citizens play video games, and all those games were purchased for personal use, especially strategy games (DeKanter, 2005). Moreover, a study by Jenkins (2005) revealed that all students from more than 20 U.S. colleges and universities had played computer and video games, and 50 percent of them have been playing computer or online games since they were six years old. Another study in 2001 found that nearly 84 percent of teenagers aged 12 to 17 owned a video game console, and 58 percent played games more than one hour per week (Thibodeaux, 2001). In addition, Jenkins (2005) showed that 65 percent of students called themselves "regular or occasional" game players. Taken together, these statistics establish that today's youth generation is highly immersed in video and computer games, and the number of people playing games has risen constantly in recent years.

Definition of Gaming

Video games are fascinating, and young children seem naturally attracted to them. But, what is a video game, and why does this learning generation spend much of time playing games? Jenkins (2005) stated, "the term electronic game encompasses a wide range of products, from shooting games involving extreme violence to sports simulations to fantasy adventure games to puzzlers or brainteasers" (p. 48). These video game products have different characteristics; however, each of them has some common characteristics: challenges and rules. When the game is rule-guided and engages players in a struggle in the context, it is an instructional game, which can train players (Cameron & Dwyer, 2005). Therefore, games provide the interactive environment where players get the direct feedback when competing

against the contender, and they realize the rules and goals of games through successive feedback (Jenkins, 2005).

As mentioned above, games supply competition, immediate feedback, and playing rules, so players are motivated to engage in the virtual environment. Along those lines, Pierfy (1997) concluded that instructional games provide a permanent interactive setting, apparent and consistent objectives, and high-level inspiration. That is to say, a player's confidence is built due to rehearsal because they get the immediate feedback while playing, so gaming can facilitate learners' organization and encoding skills. Therefore, students obtain some learning benefits when playing games.

Benefits of Gaming on Students' Learning

Bonanno and Kommers (2008) stated that, "computer games are a neglected but very important area of computer supported learning, which can promote critical thinking, strategic and logical skills, as well as cooperative and negotiation capabilities," to elicit the integration of games and learning (p. 97). Game learners discover, contest, collaborate, and value the victory in games when they confront difficulty and mistakes during game play, and even young learners are able to manage this complication (Becker, 2007). While integrating games into the instruction, students can have fun, effective, and powerful learning (Kirkley & Kirkley, 2005).

A study by DeKanter (2005) found three advantages of using games for students' learning. First, students can easily navigate this virtual environment without any other assistance since this young generation is familiar with games because most children have played them since age 6. Second, students have complete power and responsibility over game play. They can decide what directions and tools they want to go and use, and if they have

failed in a game, they have to take this responsibility. Third, students are physically and mentally involved, and their memories are enhanced. That is to say, games not only promote cognitive skills, but also active learning. In terms of these three points, students' learning can be benefited by games. Thus, taken together these studies suggested that games could be a powerful technology used in the classroom; nevertheless, games are seldom used in today's class because most teachers are not familiar with this new instructional technology.

Gaming used in K-12 Teaching

According to Becker's research (2007), nearly half of teachers are interested in using games and simulation in the classroom. However, although those teachers are interested in using games, there are some obstacles that need to overcome, such as a lack of resources and a lack of knowledge of game use. Consequently, teachers have difficulty finding appropriate games that can be effectively used for learning, and even when teachers locate these resources, few can operate and carry out these games in class.

Recently, there have been numerous studies on the gaming and simulation used in education (DeKanter, 2005; Jenkins, 2005; Kytta, Kaaja & Horelli, 2004). Nevertheless, there are few papers offering practical guidelines for in-service teachers to prepare their lessons using gaming (Becker, 2007). As a result, teachers may need help to access resources to learn how to apply them in the classroom if digital games are going to be a new teaching and learning trend in educational technology. A teacher must also be equipped with the ability to decide what, where, and how games may be suitable for them to use, and they must have confidence in understanding a game's merit and flaws, their own ability to play digital games, and when using games will improve students' learning (Becker, 2007). It is important that new and already practicing teachers experience for themselves what video games are,

and how this medium could help them educate their students. Thus, the advantages of two historical games are discussed in the following paragraphs.

Jenkin's (2005) study reported that Kurt Squire, co-developer of Revolution and one of the co-directors of the Education Arcade, has introduce a game named "Civilization Ⅲ" into high school geography and history classrooms. "Civilization Ⅲ"is a strategy game in which players develop and structure a historical civilization using negotiating. Thus, by playing this game students are able to master the concept of how history changes. Another game named "Making History" has also been used in many different subjects in high school and college. The content of this game is centered on teaching history, but it is readily applied into any learning area like economics, environmental science, and creative writing (DeKanter, 2005). These games integrate advantages of a network that help teachers make their own teaching approach that guides students' academic objectives. Game lessons can help overcome the drawbacks of traditional linear classroom teaching. Therefore, the relationship between learning and games are closely linked, so understanding the theoretical framework of constructivist learning and games is essential to comprehend why games can help students achieve their academic objectives.

Learning and Gaming Theory

Constructivist Learning

According to Papert's *Mindstorms* (1993), students' learning is self-motivated and self-directed. Students are competent and active in the learning environment where they are involved in the process. Consequently, students are no longer the information consumers; in contrast, they construct their own knowledge and problems during an active learning process. In addition, in constructivist learning the role of teachers is to guide, help, and encourage

students to think, find the problem, and solve it. Consequently, learning theories help educators decide what means they want to use to fit in this learning environment. Prior to the rise of constructivist learning, Skinner's discourse of learning was rooted in behaviorist theory, which was used in traditional education. This theory focused on the content design that stated clearly objectives and produced measurable and observable outcomes. This is an information process that learners use knowledge-based instruction to succeed in learning (Kirkley & Kirkley, 2005). That is, learning is activated when teachers advance students to learn something that is inflexible for them to digest the meaning by themselves (Braden, 1996). However, today constructivist learning theory is more widely used than traditional education theories. As a result, contemporary teachers are more likely to think that learners' experience, senses, and learning processes are more important than the content received (Resnick, 1987).

There are three principles offered by Savery and Duffy (1995) to help explain constructivist learning:

Understanding comes from our interactions with the environment. Learners' knowledge comes from their pre-existing knowledge and experience, and new knowledge is formed when connecting previous experience to the new content and environment (Bransford et al., 2000). Papert (1993) has coined the term "body geometry," which means that children do not to learn the formal rules but instead develop insights through the way they interact with space. In this way, constructivist learning is a process in which a person translates a personal experience to construct his own knowledge (Braden, 1996). Consequently, learning is built when the learner is motivated by internal elements.

Cognitive conflict or puzzlement is the stimulus for learning and determines the organization and nature of what is learned. To achieve the goals that students make for themselves, they have power to manage, organize, and choose their learning process and activities to improve their learning results (Astleitner, 2005). As a result, understanding the stimulus for learning is crucial when creating environments to help students solve their own problems to achieve goals (Kirkley, & Kirkley, 2005).

Knowledge involves social negotiation and the evaluation of the viability of individual understanding. Building a community to reflect individual learners' thoughts, answer students' questions, and discuss how students learned is an important consideration (Astleitner, 2005). This can help students reflect on their own thinking, reconstruct the memory content, and then test the knowledge again after this thinking process.

Take one example based on constructivist learning principles Gee (2004) used about playing Pokemon to explain how kids learn vocabulary. Instead of memorizing vocabulary, students put vocabulary into action, so they can transform the pre-existing concepts and knowledge into context. They are engaging in the game because they are motivated to learn what they want to do.

Bransford et al. (2000) also defined four learning environments—learner-centered, knowledge-centered, assessment-centered, and community-centered. When integrating instructional technology in education, students and teachers can obtain lots of benefits in teaching and learning. In a learner-centered environment, technology provides an active and interactive environment in which students can assess the real-world problems and environment without going to the real place, so students can develop their ideas and creativity within this technology-based and learner-centered environment. The technology-

based tools in knowledge-centered environment provide students with information to solve problems and enhance their performance when doing the complex tasks. By means of these practical applications, they gain higher order thinking and develop problem solving skills. Within assessment-centered environment, technology serves as the communication tools that can be used to provide useful feedback and reflection on what is learned to students and teachers. Hence, students revise and rethink what they have learned from others' ideas, thoughts and portfolios in the classroom. Technologies can build a community-centered environment where students' activities could be seen by the school community and other professionals, students, and parents outside the school. Consequently, technology is a means to facilitate students' learning in both schools and homes, and games are one tool used in this way.

Game Object Model

To create an authentic learning environments in this high-tech period, using technology in education can be the best way to facilitate and assess students' learning because technology not only provides information, but also inspires some assumptions and ideas when using the computer programs or applications. To this end, educational computer games can be one tool used in teaching and learning, but to be appropriately used in education, games should be relevant, explorative, engaging, and competitive to support authentic learning (Amory, 2007). An original theoretical framework of a game, the game object model, was presented by Amory et al. (1999).

The game object model, the GOM, contains several objects, which include abstract and concrete interfaces of each one. Abstract interfaces relate to pedagogical and theoretical

concepts, and concrete interfaces refer to design elements. The five GOM objects are described below (Amory et al., 1999).

The game space object includes play, exploration, challenges, and engagement, which are all inspirational abstract interfaces.

The visualization space includes cognition abstract interfaces—critical thinking, objective formation, goal completion, competition, and practice—and includes one concrete interface: story line.

The elements space object includes fun and drama that are abstract interfaces, and graphics, sound, technology, interaction, and gesture that are concert interfaces.

The actor space object includes drama, interaction, and gesture interfaces.

The problem space object includes management, judgment, memory, and reflection concrete interfaces.

However, Amory (2007) updated the GOM named GOM Ⅱ to present a framework for the development of educational or traditional commercial games. It includes several subsections: definition of computer games, authentic learning, narrative, gender, social collaboration, and challenges-puzzles-quests.

Games includes exploration, challenges, engagement, emotive, complex, dialogue, and relevance interfaces. Thus, educational games should create environments where solutions need various dialogues to solve complicated challenges.

Authentic learning includes authentic, multiple views, transformational, relevance, and model-building interfaces. Games should produce authentic task-based learning environments that include model building where learners can represent and transform their knowledge into games.

Narrative includes narrative spaces, challenges, story, plot, and back-story interfaces. That is, educational games should build an environment where plot and story exist in the settings, so learners can construct their own story and understanding via this narrative space.

Gender includes gender-inclusive, activity-based, game rhythm, role models, and conflict interfaces. To create an inquiry or experiential game that is useful for both males and females, and user interface and interactions should be obvious rather than obscure.

Social collaboration includes democracy, social capital, dialogue, CMC (Computer Mediated Communication) Network, CMC tools, SNA (Social Network Analysis) visualization, and relationships interfaces. Therefore, learning happens when dialogue occurrs in the social context. Through these new technologies and CMC tools, learners develop new insights within this social community.

Challenges-puzzles-quests includes tacit-knowledge, puzzlement, accommodation, assimilation, reflection, explicit knowledge, conversation, and relationships interfaces. It is a basic learning activity that supports learners in accessing specific knowledge.

Games Motivational Design

Teachers must understand how to stimulate students to learn because only through this strategy can teachers make an effective instruction, and students can absorb the knowledge actively, but will not passively implant the information they are not interested. Keller (1987) introduced the ARCS Motivation Model to help educators recognize the relationship between human characteristics and the motivational components. There are four major elements presented in the ARCS Model, which are attention, relevance, confidence,

and satisfaction (Keller, 1987). First, attention is to grab students' interests for the learning subject, so students have the curiosity to dig into the knowledge what has been taught. Keller (1987) also defines perceptual arousal, inquiry arousal, and variability as the strategies that create the environment, instruction change, and problem situation to catch learners' interest. Thus, games can easily catch learners' attention since they are seldom used in classroom settings for teaching and learning.

Next, to motivate learners to learn, an educator should make clear the relevance of the learning subject. Namely, if learners recognize the importance of the topic and have a constructive feeling about the meaningful materials and instructions, then they will be motivated. Goal orientation, motive matching, and familiarity are three strategies that provide the benefits and familiar concepts of the instruction to produce relevance for learners (Keller, 1987). From Jenkins's article (2005), 50 percent of students have played computer or online games since they were six years old. Hence, games are relevant for students' learning because most of them are familiar with game play, and they can also define their own goals through playing.

To help instill confidence in the learners is the third component of the ARCS Model. If the learners know what they will get out of the instruction, they will expect their success, and confidence is built as a result. Learning requirements, success opportunities, and personal control can increase learners' confidence by presenting learning criteria, success examples, and feedbacks (Keller, 1987). Therefore, students have the full control while playing a game, so their confidence is built when getting the feedback through game play. Lastly, satisfaction can strengthen learners' learning. That is to say, offering real-world simulations, performance tests, and prizes can continuously motivate learners to learn

(Keller, 1987). Consequently, students get satisfaction when they win the game; in contrast, they would challenge themselves playing again to achieve their satisfaction.

Constructivism Built into Games

Savery and Dufffy (1995) presented seven constructivist principles, which can be applied to the overall learning environment. Thus, in order to put theory into practice, the relationship between these constructivist principles and game design will be described below:

Anchor all learning activities to a larger task or problem. Jenkins (2005) revealed that players may feel challenged, but not overwhelmed when games set a great challenge and present initial scores that can motivate players to keep going in the task. Therefore, games are powerful tools to help learners succeed because they can encourage learners to face challenges and learn.

Design an authentic task. Learning is motivated when games set clear goals, or players play a role as leaders to set their own objectives during the game play (Jenkins, 2005). Learners can solve an immediate problem in terms of what they have learned within this virtual environment.

Design the learning environment to reflect the complexity of the environment in which the learner should be able to function at the end of learning. Jenkins (2005) stated that "games are multimodal" (p.50). That is, games include text, images, graphics, and animation to support multiple learning styles. Different learners have different learning modes, so in order to make learning more powerful, games integrate multiple forms to make different learners act and absorb better in the game play.

Support the learner in developing ownership for the overall problem. Games promote an engagement when learners immerse in play (Jenkins, 2005). Children can control

each element and observe what happens when they travel in this virtual world. They can make any choice at any time based on what they do and see in this event.

Design the learning environment to support and challenge the learner's thinking. Players look for more information that supports them in expanding their knowledge in a new subject area through game play (Jenkins, 2005). Learners gain the knowledge through continuous practice, so they may be inspired to do more research when they are curious about unknown subject area that is drawn out from play.

Encourage testing ideas against alternative views and alternative contexts. Games provide the environment where players learn by diving, losing, and then rebooting (Jenkins, 2005). Games encourage learners to make mistakes and explore new ways to solve problems, so learners have a chance to try again and again in order to apply what they learn to new contexts.

Provide opportunity for reflection on both the content learned and the learning process. Players can share their playing experiences, knowledge, and tips with other players who have the same interest in games (Jenkins, 2005). Games create a social context that allows players to reflect on their thoughts and knowledge with their peers. Learners' insights have been reinforced, and they can gain expertise through the experience sharing.

Arts Education in Elementary School

Current Status of Arts Education

During the 1990s, policy makers recognized that arts instruction is an important subject in America's schools. The U.S. Congress reconfirmed the worth of arts education in Educate America Act of 1994, so arts have been placed into the core curriculum in K-12

education and classified into visual arts, music, dance, and theater (Warburton, 2006; Americans for the Arts, 2006). Nevertheless, the report from Americans for the Arts (2007) described that school districts do not have high quality arts program in these four disciplines for all students because they lack of teachers, materials and funds to support 100 schools and 31,000 students.

This report also pointed out that some elementary schools do not offer dance and theatre program, classroom teachers are not professionally qualified in visual and performing arts, visual arts specialists are not available in elementary school, schools do not have enough visual arts materials for children because of funds shortages, and schools lacks funds for music instruction in kindergarten through grade three (Table 1). Consequently, few students' experience arts instruction due to lack of arts resources and teachers. Similarly, Warburton (2006) revealed that limited resources and access to arts damaged all levels' arts instruction, especially K-12 arts education, because K-12 education is the seed for future postsecondary arts education. The numbers of arts faculty who hold doctoral degrees has decreased from 47 percent to 39 percent between 1987 to 2003. Compared with other program areas, only 63 percent of arts faculty members have PhDs degree, while 94 percent of faculty members in other disciplines hold PhDs (Warburton, 2006).

Table 1
Description of current status of arts education in elementary school

Area	Teachers	Materials	Musical Instruments	Program Evaluation
Elementary school	No visual arts, dance and theater teachers exist. Funds only for 6 music teachers for 30 elementary schools.	Textbook in music is limited, and no textbook in visual arts.	Students in fourth and fifth grades have to rent their instruments.	No formal evaluation taken place in arts program.

Note: This table outlines data from a Community Arts Education Project

Arts Education and Academic Achievement

A research report by Americans of the Arts (2007) showed "students achieve at a higher level when they are engaged in the four "R's- Reading, wRiting, aRithmetic, and the aRts" (p. 9). The arts not only give children the opportunity to express their emotions and perspectives, but also challenge them to encounter new ideas and investigate new cultures and world around them (Joseph, 2002). Art brings students enjoyment, and it can enhance their intellect, learning abilities, and skills.

Specifically, students gain creativity, skills, and knowledge when learning the arts, and they begin to perceive the overall value of arts. Arts can lead young children to increase their memory, social interaction, confidence, and understanding of different cultures, and it also gives the foundation for children to practice their speaking, reading, and writing skills. Through arts activities, students are motivated to seek and learn more to collaborate with other subjects, so they build critical thinking skills in order to find out the meaning of each object. Overall, students can improve other academic subjects when involving in high quality arts programs, especially in mathematics and reading (Americans of the Arts, 2007). In sum, arts are important in young children's education because it helps children to develop their early thinking, verbal skills, and creativity.

Catterall and Peppler (2007) described that a main idea of constructivist learning in visual arts is metacognitive activities, which means that learners actively examine their own learning and thinking process. So, metacognition happen in the visual arts when students create their visual arts works by reflecting and modifying their own ideas continuously. In this creative process, students develop, try out, reflect, and redesign their art works, and

while immersing in this process repeatedly, it helps young children to write and revise an essay (Catterall and Peppler, 2007). Therefore, arts may be seen as the core academic subject in elementary school since may establish a foundation for other academic subjects.

Benefits of Visual Arts at the Elementary Level

Jonson (2008) pointed out that it is necessary for children to experience the visual arts because through the learning activities, children are able to build the visual literacy that is developed by their visual and verbal expression. Young children can communicate their messages using the arts materials, such as markers, papers, clays, colors, and so forth; therefore, by playing with these materials children make and interpret their ideas into visual symbols. Meanwhile, to convey these symbols to other people children need to talk with others about what the symbols are and what they represent. Through this active expression, young children can develop superior visual literacy for the future.

From the above description, visual literacy includes how to read, make, and talk about the arts. Johnson (2008) reported that "visual literacy is the ability to create visual messages and to read message contained in visual communications; to perceive, understand, interpret, and, ultimately, to evaluate one's visual environment" (p. 74). Specifically, teachers should first introduce the simple concepts of arts like color, shape, or pattern and then give students the chance to experience and extend the concepts so children express their interpretation creatively. Later, teachers should encourage children to talk about the thoughts about their artifacts. Consequently, when children play with the media, they experience what the visual arts are and then further develop their visual literacy.

In addition, Hetland and his colleagues (2007) concluded that High Quality Visual Arts Education, HQVAE, promote six learning characteristics for children. HQVAE elicits

children's *engagement* and *persistence* when working on their artworks. It also provides the opportunity for children to *envision* their future or something they cannot see immediately. Followed by envision, children can *express* their individual meanings and emotions using the art materials, so their expressions can become fantastic artworks. Afterwards, children *reflect* on their creations and thoughts in order to communicate their visual message accurately with their peers, teachers, and parents. During the reflection process, they develop the problem solving skills. After all, children construct the skills of *stretching, exploration, and taking risks*. In general, arts, core subjects in elementary school, are essential for young children's education because while involving in the arts, children develop their reading, thinking, verbal skills, creativity, self-confidences, as well as problem solving skill. These learning outcomes help students apply these skills into other academic subjects.

Benefits of using Web-Based Multimedia in Visual Arts

Abrahmov and Ronen (2008) combined a Web-based model with on-campus practice in a college-level photography class. They used two different teaching methods in class: on-campus activities and online activities. On-campus activities follow the traditional teaching structure where students do the practical photographic skills, and online activities include the introduction and discussion of visual literacy. These online activities have six different sections, which asked students to choose portraits and photographs from a recommended site and to explain their selection, the concept of focal points, and their response to the portraits and photographs.

Through these types of online activities, students were able to develop their reading and writing skills. That is, students gained the skills of reading the meanings of photographs, so they are able to make the meaningful photographs. Consequently, this Web-based

multimedia helped students to build up their visual reading skills via guided activities (Abrahmov & Ronen, 2008). Students not only practiced the practical photography skills in class, but also obtained the skills of reading the visuals and conveying their own perceptions through online activities. This process facilitates students to think, critique, express, and reflect on their own photographs in depth.

Summary

Based on previous research, this review concluded that games could be an important educational technology in today's classrooms because several studies have offered evidence that games could facilitate students' interest and achievement in the content area. Furthermore, it promotes higher order thinking and develops problem-solving skills when students interact with the context of games. Consequently, using games correctly in teaching can increase students' learning. However, this review also showed that high numbers of teachers have a desire to integrate games into their lessons, but most of them do not have enough knowledge of game use and how to locate and evaluate them. Moreover, although gaming in education has grown recently, most games are used in high schools and colleges, rather than at elementary level. Meanwhile, gaming is frequently and broadly used in social science areas, such as the examples provided in the literature review. In contrast, no literature has yet focused on arts education. Arts play an important role in young children's learning process since it helps students absorb the knowledge and understand the concept of other academic subjects easily. Yet, the arts often unfunded by most school districts, especially in elementary schools. Schools lack teachers, materials, and funding to supply adequate arts instruction, so the arts are usually neglected as a core curriculum subjects.

In conclusion, the literature indicates gaming effectively used in teaching and learning, and it can be applied to each subject area. Thus, the researcher assumes that by using games the instructor can not only produce more valuable lessons for students to engage in arts elements and concepts, but also that students will be active in learning and have a stronger sense of the implication of artwork when they create and distribute their ideas and reflections. Games are a visible declaration of a new generation who accesses materials in an active way during the learning process. Further, students are able to think more critically and develop an appropriate and meaningful project what they apply their understanding and creativity obtained from game play. Overall, this technology is one of the greatest teaching aids in the arts classroom, especially for school districts where arts teachers and materials are lacking. However, teachers, educators and school districts should experience and understand the effects and appropriateness of gaming before they use it in class. Finally, this study provides the groundwork for future research on adapting gaming to arts educational environment as well as gaming used in elementary levels.

Research Questions

The purpose of this study is to understand the cognitive and affective impact of a Web-based Flash game has on teaching visual arts to elementary grade students. This Web-based Flash game is called “Color in Motion,” which helps people to understand the basic color attributes and color symbolism, and features of this game are illustrated in the next chapter. Therefore, from the literature review, two research questions are generated as follows.

Research Question 1: What is the impact of the Web-based Flash game on students’ learning of basic color attributes and color symbolism?

Research Question 2: How do students engage, persist, express, and explore while interacting with the Web-based Flash game?

CHAPTER 3. METHODOLOGY

This study aims to investigate the cognitive and affective impact that a Web-based Flash game has on teaching visual arts to elementary grade students. The Web-based Flash game examined in this research was originally developed by Cortés (2003), and it explores basic color attributes and color symbolism. Before data collection, approval was granted by the committee of Institutional Review Board at Iowa State University, which reviews all research involving human subjects for compliance with federal regulations. Thus, the information given by the participants was kept confidential and their participation was volunteered. All names used in this study are pseudonyms.

Instructional Game "Color in Motion"

The Web-based Flash game, called "Color in Motion," was designed and developed by Cortés (2003) as a tool for students to experience different colors. "Color in Motion" focuses on basic color attributes and symbolism, and through the game students get to know each color, view short movies about each color, and participate in interactive activities involving colors, all with the purpose of building students' knowledge about color. Students experience the game individually, and while playing the game, learners have full control over the environment and multimedia, allowing them to start and stop the game as necessary. However, teachers may provide a brief introduction about the game before students start to play and offer support along the way as needed. Later, students also create artwork that presents their understanding about colors as learned from playing the game.

The game is made up of three sections. The first section is "the star." It presents six animated people with different colors, which are red, yellow, green, blue, and violet (Figure 1). Each character carries a folder with profiles and information on basic color attributes, and

to view the content, students need to click one of these folders. After a student clicks on the folder, an animated square piece appears on the right hand side of screen, where students can read about basic color attribute information.

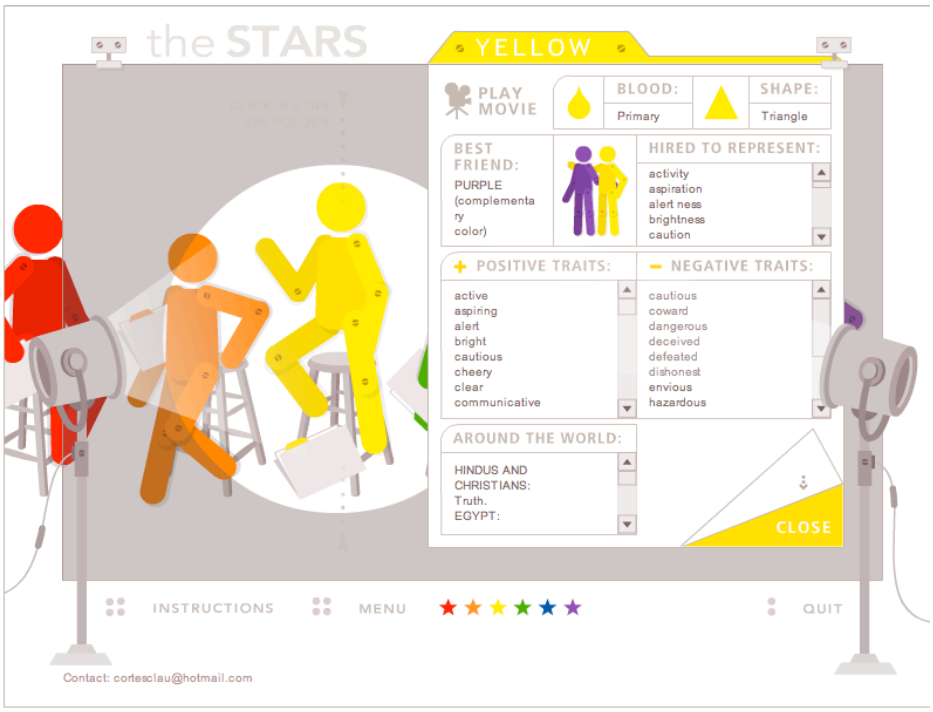

Figure 1. "The star" section

The second section is "the movie," which includes movies for six colors. The movies are played automatically based on the order of colors (Figure 2), but movies can also be played individually by clicking on a character. Each color's movie includes the visuals and meanings that a color represents, so the movies also reinforce the associations between verbal and visual information. That is, the movies facilitate the recognition of color symbolisms that are presented in the previous "the star" section.

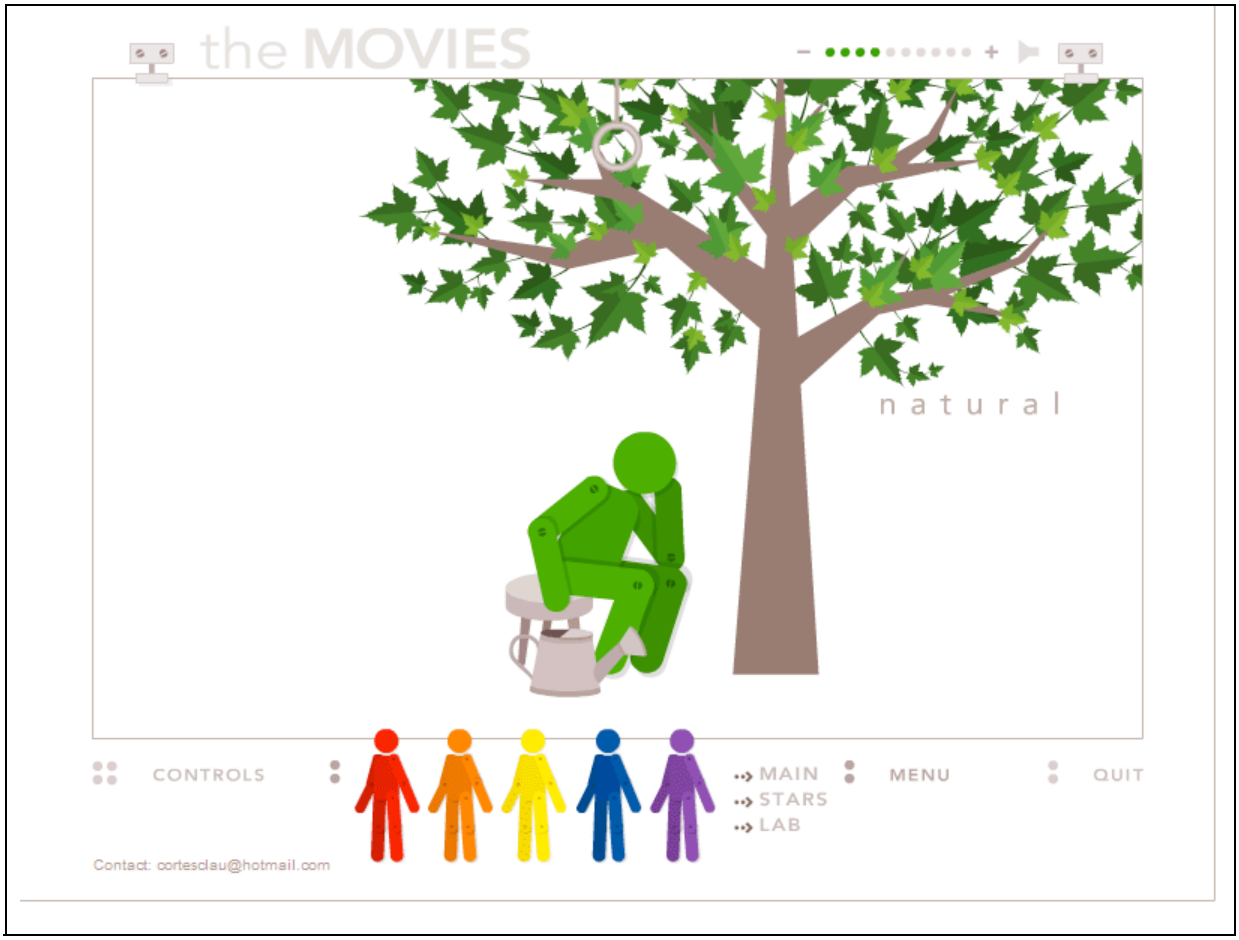

Figure 2. "The movie" section

The third section, "the lab," allows learners to engage in hands-on activities, and it consists of three different parts (Figure 3). The first part is designed as a place for learners to develop their imagination and creativity. Learners select a color and create a scene that represents the symbolism of a particular color. In part two, learners match a color with applicable symbolisms; consequently, students come to understand how much has been learned from the previous sections. Learners also can simply enjoy the colors by mixing and matching them in part three.

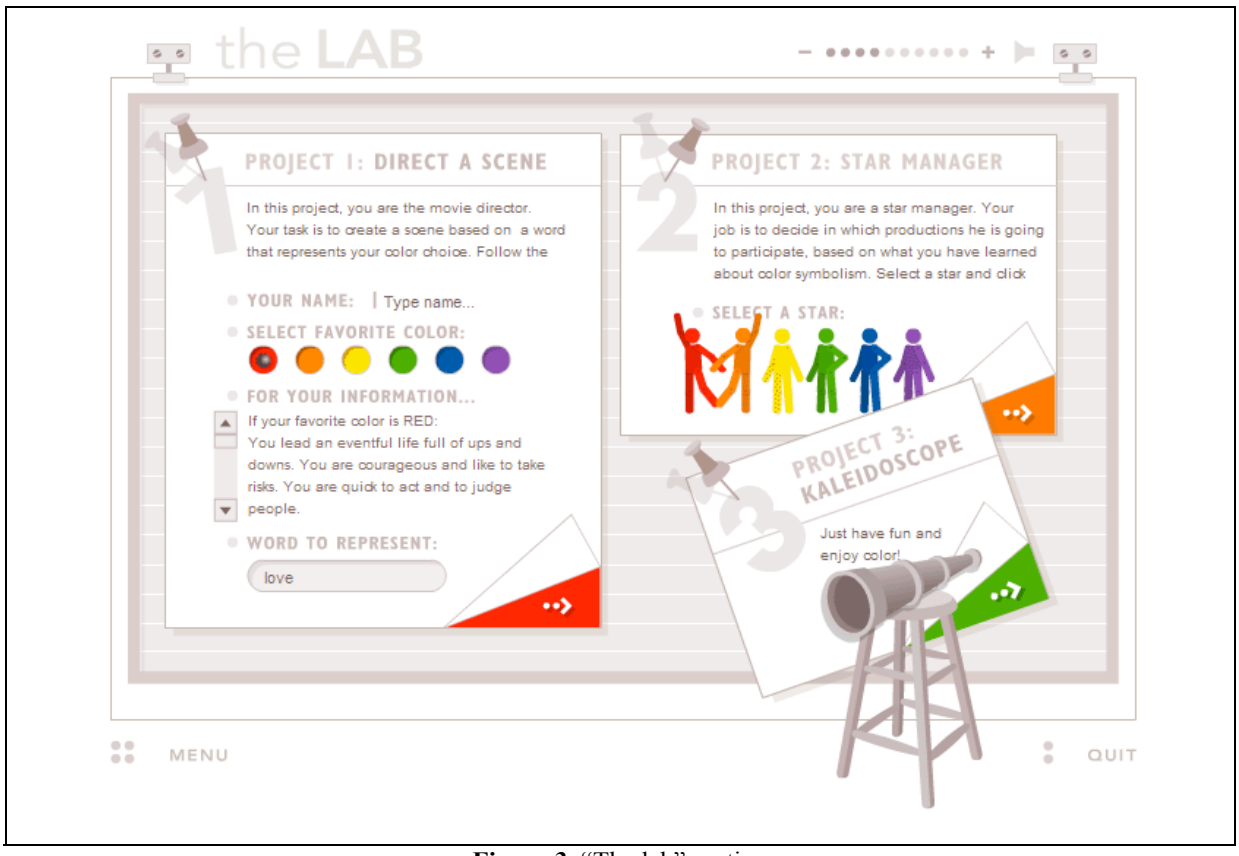

Figure 3. "The lab" section

Research Design

According to the Fitzpatrick et al. (2004), a participant-oriented naturalistic evaluation is the best way to understand the structure of reality and to involve in and observe the surroundings of everyday events. Therefore, this method was used to identify the outcomes of Web-based Flash game "Color in Motion" as adopted in an after-school club. The evaluation took place in routine life, where an evaluator seeks the truth from informers and the informers give the knowledge to evaluator. Consequently, descriptive information was gathered for this study since the research aims to investigate the cognitive and affective impact that a Web-based Flash game has on teaching visual arts to elementary grade students. In addition, several kinds of valuable information can be collected by the

naturalistic evaluator, including the object of the evaluation and information about concerns, issues, values, expectations, and needs (Fitzpatrick et al., 2004).

Participants and Contexts

Six recruited students from a Midwestern after-school club participated in this study. The participant group consisted of four females and two males, of which four were Caucasian and two were African American. Three were fourth graders, and the other three were fifth graders. All participants belong to an after-school club that offers youth programs and activities. The after-school club contained four main areas that are a learning center, teen center, games room and gym. A learning center is a room for all children to do an independent study. A teen center is a place where it has two computers, a flat screen television and DVD equipment for children ages 13-to-18 to use. A games room is an open space that connects directly to the kitchen, the teen center, the learning center and the gym, and children could play pool, foosball, checkers or other games here. A gym is the largest area that offers basketball and other types of physical fitness for youth. Most children gathered in the club from four to eight post meridiem. The research activities were conducted in the learning center. The learning center is surrounded by the yellow walls covered with kids' artworks, pictures, and posters, and the area is brightly lit with both natural light and lamps on the ceiling. The learning center has a large working area with three large plastic round tables and lots of plastic chairs; the computer area faces a wall with six PC desktops. A small staff work area with a wood desk and a PC computer in located in a corner, a television is in an opposite corner, and several shelves with books, tools, and games are scattered around the area. Every afternoon in the learning area kids may do their homework, play with toys and games, read books, draw pictures, use computers, watch movies, listen to music, or

chat with other kids and club staff. Sometimes workshops and activities are also held in the learning center. Consequently, most of the time the learning center is loud and full of the people.

Figure 4. A learning center

Methods

Both quantitative and qualitative data were collected from multiple sources: pretests and posttests, observations, recordings of on-screen game play activity, and interviews (Table 2). 10-to-12-year-old students took pretests and posttests before and after they played the game, and by comparing the test results, the researcher identified if intervention had cognitive effects on learners. Observation data were collected while learners were playing the game, and recordings of on-screen game play activity were also used to strengthen the depth and completeness of observation. From the observations and recordings of on-screen game play activity, information about concerns, values and expectations were gathered and informed the affective impact of gaming on students' learning. Interviews were conducted with each learner after the gaming activity was finished. In order to better understand the cognitive and affective impact of the Web-based Flash game on students' learning, each learner was asked a few questions about their thoughts and feelings towards the Web-based Flash game.

Table 2
Research questions and methods matrix

Research Questions	Selection Decisions	Participants	Data Collection Methods
What is the impact of the Web-based Flash game on students' learning of basic color attributes and color symbolism?	To assess the cognitive and affective impact of gaming on students' learning.	10-to-12-year-old students	Pretests and Posttests Post-instruction interviews
How do students engage, persist, express, and explore while interacting with the Web-based Flash game?	To assess the affective impact of gaming on students' learning.	10-to-12-year-old students	Observations Recordings of on-screen game play activity Post-instruction interviews

The development of the pretest and posttest, observation grid, and interview guide was based on the Torrance Test of Creative Thinking (Scholastic Testing Sesirvice, 2007).

Pretest and Posttest

According to Dimitrov and Rumrill (2003), the content of the pretest and posttest must be the same for a valid and reliable assessment, so in this study identical pretests and posttests were used. Furthermore, the second component of TTCT, the Figural TTCT, includes abstract pictures and testees are required to assert what the image may be. In accordance with this second component, the test in this study was divided into two parts: basic color attributes and color symbolism (Appendix A). For the basic color attributes section, a total of 12 fill-in-the-blank questions were used, and the section contained the questions such as "The blood type of color red is_____," and "The complementary color of red is_____." Two questions were asked for each color (red, orange, yellow, green, blue, and violet), and learners respond to each question by filling in an appropriate answer. From

the data collected, the cognitive impact was determined, meaning whether learners could recognize the basic color attributes based on the gaming experience.

The second part of the test was based on the second component of TTCT. Six color images were provided, and learners were asked to write down two to three adjectives to describe each color. Through this process, learners were able to develop their thinking, and it also allowed evaluation of whether or not students recognized color symbolism after they played the game.

Observation and Recording of On-Screen Game Play Activity

An observation grid was used in this study (Appendix B), and this grid allowed the researcher to jot down notes during game playing, letting her keep track of how learners worked and interacted with the game. The three evaluation criteria for assessing students' learning motivation had been translated into observable behaviors. Based on the first and third components of TTCT, the dimensions of creativity thinking including resistance to premature closure, elaboration, abstractness of titles, and originality. Four statements were developed as observable behaviors. The first, second, and third statements of observable behavior are "Student shows curiosity on his or her facial expression," "Student is actively engaged in the game," and "Student has played the game from beginning to the end without missing any segments." The first three statements represent the dimension of resistance to premature closure. The dimension of elaboration, abstractness of titles, and originality is presented on the fourth statement as "Student has produced many unique images while playing in "the lab" section. In addition, the researcher described the context where the activity was taking place. In order to make the observation more complete and reliable, the researcher also commented on additional observable behaviors in the "other" section.

Meanwhile, an on-screen recording software was used to record each learner's game play activity. This instrument captured the details happening on screen that the researcher might not notice during the game play observation. The data from the observation and the recording of on-screen game play activity helped the researcher to understand the affective effects of playing the game on students' learning about basic color attributes and color symbolism.

Interviews

Interviews consisted of five open-ended questions that were used as a guide during the interview. From there, the researcher could modify the wording and the order of the questions depending on the participant's answers (Appendix C). According to Adler & Clark (2008), qualitative interview guides helps researchers to gather insights, attitudes, and life meanings of the interviewees by exploring with them. Consequently, this study used the interview to collect perceptions and feelings about playing the Web-based Flash game as a way to learn visual arts. These questions provide data on understanding the cognitive and affective impact on students' learning on basic color attributes and color symbolism.

Pilot Study

Following Institutional Review Board (IRB) approval, a pilot study was conducted primarily to identify the practicality and feasibility of the evaluation process and data collection instruments. The pilot study was conducted in a university usability lab that has eight desktops and is a small and quiet place for students to use and to conduct usability tests. While conducting this pilot study, only the researcher, a participant, and the lab monitor were in the lab. Two fifth grade female students from a local elementary school participated in this pilot. After the parental informed consent documentation was signed, the participants

engaged in the evaluation activities individually and separately with the researcher. Before they began to play the Web-based Flash game, the researcher read the assent form to each student. After the student signed the form, they were asked to do the pretest, to play the game, and to respond to the posttest. The participants then had an interview with the researcher after they finished the posttest, and in the interview they were asked about what they learned and how they felt about playing the game. During the playtime, the researcher observed their playing activity using another computer, which was connected to a computer they used. Consequently, their on-screen game play activity was recorded and showed on the screen the researcher used.

The major findings from the pilot study showed that the data collection instruments were appropriate. Based on the pretest and posttest results, both students improved their scores apparently. One student improved 80%, and the other one improved 70%, so the average the improvement rate was 75%. In second part of the pretest and posttest results, both students mostly recognized the right color symbolism in their posttests, but they did not know the meanings that each color stood for in their pretests.

Furthermore, the results of observations and recordings of on-screen game play activity showed that both students demonstrated persistence, expression, and exploration behaviors during their playtime. For instance, both students clicked all six colors to get the information in “the star” section, they watched the movies on all six colors, and they completed all three projects in “the lab” section. Both students tried the drag props, draw, erase, and delete functions in “the lab” project one; they also played with many color droppers and background colors in “the lab” project three. In addition, the students also reported in their interviews that the game motivated them to learn the basic color attributes

and color symbolism. Nevertheless, one participant responded that she had a hard time figuring out where to click and how to move while exploring the game. This explained why both students sighed or frowned at times while playing the game. Based on these findings, no changes to the collection instruments were made, but a brief introduction and simple demonstration of the game was added before students began playing the game.

Procedures

Following the pilot study, the researcher made initial contacts with prospective participants via an after-school club visit. The United States Department of Health and Human Service regulations specifies that participants under age 18 need to have parents' permission to be involved in human subject research. Consequently, the researcher gave a brief description of the study and distributed the parental informed consent documentation to the six10-to-12-year-old students who were interested in participating. After the signed parental informed consent forms were collected, the consent form was given to participating students. The researcher read out loud the information in the form as well as asked if the students had any questions. After students signed the consent form, the researcher scheduled the research activities with each student, and each student met with the researcher at a convenient time and engaged in the research activities individually. The data collection lasted nearly a month from February 12th to March 2nd.

During each research session, a computer was set up for the student, and the researcher loaded the game before the research activities began. The first activity was for the student to take the pretest, which took about five minutes to finish, and afterwards the student was asked to use the computer in front of him/her to explore the Web-based Flash game. The researcher assumed that prior to the games, students did not know a lot about basic color

attributes and color symbolism, so doing a pretest would increase their interest in exploring the game. The game play activity took about 20 minutes, and while the student played the game, the activity was recorded and the researcher observed the student's game playing behavior in real time. Following the game, students took the posttest, which took three to five minutes. Finally, the researcher had a short individual interview with each student.

Data Analysis

In order to capture learners' knowledge gained from playing the game, descriptive statistics were used to examine the correct response of each question in the first part of the pretests and posttests, and then compare the results between pretests and posttests. The answers to the second part of the tests were entered into Microsoft Excel, and then compared with the wording between pretests and posttests. Therefore, the researcher could identify if the game created the anticipated effects on students' cognition of basic color attributes and color symbolism. Results of the pretests and posttests were imported into Microsoft Excel, and frequencies and percentages for questions were calculated for the first part of the tests. In addition, Excel's charting feature was used to generate a double bar graph of compared results.

The observation field notes, recordings of on-screen game play activity, and interview responses were analyzed using categorizing analysis; analytic files were used to store and organize the data by categories. According to Maxwell (2005), categorizing analysis assists researchers in making comparisons and developing concepts into themes. In addition, these files help the researcher to keep track of meaningful information (Glesne, 2006) and easily retrieve data by category. Theoretical categories were used to analyze observation field notes and recordings of on-screen activity. That is, these categories were developed from prior

theories that gaming motivates students' learning in which the data support those theories (Maxwell, 2005). Furthermore, recordings of the interviews were transcribed and evaluated using a coding system: the sentences and paragraphs were coded, counted, and analyzed line by line, and then recurring themes and patterns were identified (Glesne, 2006). These categories represent the participants' concepts and beliefs in their own words (Maxwell, 2005). Consequently, from the themes identified, the researcher made conclusions about critical incidents and issues.

CHAPTER 4. FINDINGS

Throughout the study, data were collected using four data collection instruments, and findings are presented in the following sections. They are organized by research question.

What is the Impact of the Web-Based Flash Game on Students' Learning of Basic Color Attributes and Color Symbolism?

Results Regarding Basic Color Attributes of the Pretest and Posttest

The first part of the pretest and posttest helped to determine if a student could recognize the basic color attributes presented on "the star" section of the Web-based Flash game. As seen in Table 3, a total of 12 questions were asked of all students. *Student A* responded to 12 questions, with 10 correct answers in the pretest. In the posttest, she answered 11 correct questions. The improvement rate was 10%, and there was no notable change between the pretest and posttest results because she only got one more correct answer in the posttest versus the pretest.

Table 3

Results regarding basic color attribute

Student Code	Total Number of Questions	Pretest Correct Answer	Posttest Correct Answer	Improvement Percentage
A	12	10	11	10%
B	12	10	12	20%
C	12	4	3	-10%
D	12	6	6	0%
E	12	0	6	60%
F	12	5	4	-10%
Average	12	5.83	7	11%

Student B answered 12 questions, with 10 correct answers in the pretest, and she responded all questions correctly in the posttest. That is, she got two more correct answers in the posttest (Table 3). It shows that this student indeed had a good understanding of basic color attributes after she played the game.

Student C responded to 12 questions with four correct answers. However, in the posttest he answered only three answers correctly, so he got less correct answers in the posttest than in the pretest (Table 3). He did not improve his score; in contrast, he did worse than before. This student did not get enough knowledge about basic color attributes as shown in his pretest and posttest.

Student D responded to 12 questions, with six correct answers, in the pretest. In the posttest, she also answered six correct questions. Although there was no score change between the pretest and posttest results, in the posttest the student got two correct answers that she did not answer correctly in the pretest, and she got two answers wrong that she answered correctly in the pretest. These results suggest that the student did show a little improvement, but she also regressed on the basic color attributes knowledge after playing the game (Table 3).

Student E answered 12 questions with zero correct answers in the pretest, but he responded correctly to six questions in the posttest (Table 3). The results show that before he played the Web-based Flash game, he was unaware of basic color attributes. However, he indeed had a good understanding of basic color attributes after he played the game.

Student F responded to five correct answers in the pretest. However, in the posttest she only got four correct answers (Table 3). She did not improve her score after playing the game. This student was unaware of color attributes before playing, and she showed inadequate understanding about basic color attributes after she played the game.

Results Regarding Color Symbolism of the Pretest and Posttest

The second part of the pretest and posttest sought to examine whether a student was already aware of color symbolism before playing the game and could recognize the color symbolism after they played the game.

Student A used the words like "hat," "bright," or "mellow" to describe the colors in the pretest (Table 4). It appears that she described these colors mostly based on what she could observe directly in her life and connected these concept to the colors. In contrast, Table 4 illustrates that in the posttest she typically used symbolism-type words like "peaceful," "positive," and "free," which were displayed in "the movie" section of the game. This indicates that this student learned the information about color symbolism from the game.

Table 4

Results regarding color symbolism

Student Code	Question (Color Symbolism)	Pretest Answers	Posttest Answers
A	Red	Warm, hat	Beautiful, hot
	Orange	Warm, bright, hot	Nice, mellow
	Yellow	Bright, exiting	Positive, exiting
	Green	Cool, mellow	Peaceful, calm
	Blue	Cool, watery	Peaceful, free
	Purple	Cool, watercolor	Calm, cool
B	Red	Anger, rage	Alert, evil
	Orange	Boisterous, wild	Active, hot
	Yellow	Bright, happy	Young, cheerful
	Green	Mellow, low	Evil, nature
	Blue	Melancholy, sad	Melancholy, calm
	Purple	Calm, peaceful	Royal, luxurious
C	Red	Apple	Fire
	Orange	Orange	Campfire
	Yellow	Banana	Smile
	Green	My shirt	Friendship
	Blue	Sky	Peace, love
	Purple	My shirt	King and queen
D	Red	Mad, angry	Happy
	Orange	Happy, excited	Sincere
	Yellow	Regular, OK	Excited
	Green	Natural, not upset, happy	Friendly
	Blue	Sad, upset	Depressed
	Purple	Happy, excited	Luxurious
E	Red	Hot, fire	Anger
	Orange	Orange	Fire
	Yellow	Sun	Sun

Table 4 Continued

E	Green	Grass	Grass
	Blue	Sky	Sky
	Purple	N/A	N/A
F	Red	Love	Hot
	Orange	Patient	Creative
	Yellow	Impatient	Wisdom
	Green	Nervous	Patient
	Blue	Calm	Protective
	Purple	Scared	Friendship

Student B used symbolism regularly to depict all six colors in the pretest, like "anger," "sad," and "peaceful" (Table 4). Although this student understood color symbolism, she wrote down these words in terms of her own beliefs toward colors. She asked the researcher what she needed to write in this part before she used her imagination to develop answers. Likewise, Table 4 shows that she also used symbolism to describe all the colors in the posttest, but the words she selected for the posttest were based on what she watched in "the movie" section of the game.

Student C used items that appeared in his daily life to describe each color, connecting colors to things in his life like "apple" and "my shirt," in the pretest (Table 4). Later, student C also used the words like "campfire," "smile," and "king and queen" to describe some colors in the posttest (Table 4). Interestingly, these people and objects were features in animations in "the movie" section of the game. Even though this student did not remember the specific symbolism of some colors, he indeed got some information through the movie and its animations.

Student D used symbolism to illustrate most colors in the pretest (Table 4), but she repeated same words, "happy" and "excited," to describe different colors, so it shows she did not actually know a lot about varying color symbolism. As seen in Table 4, she later wrote only one word to describe each color in the posttest. The symbolism she wrote for each color

in the posttest was exactly what appeared on "the movie" section of the Web-based Flash game. This student appears to have acquired more correct knowledge about color symbolism.

As seen in Table 4, *Student E* described colors in terms of things he could see in his life, like "sun," "grass," and "sky," in both the pretest and posttest. These responses illustrated that he did not know any color symbolism, and his answers in the pretest and posttest were almost the same except the first two colors (Table 4). This shows that this student still maintained the same thinking for most colors and did not absorb the adequate knowledge of color symbolism after playing the Web-based Flash game.

Although *Student F* used symbolism to describe each color in the pretest, most responses did not represent the colors correctly (see Table 4). This student described the colors based on what she imagined in her mind, but she did not have enough correct knowledge about color symbolism. Yet, as Table 4 illustrates, she wrote only one symbolism word for each color in the posttest, which was the correct description on each of the five colors based on what she observed in "the movie" section of the game. That is, student F learned about color symbolism as a result of playing the game.

Interview

Five open-ended questions were asked during the interviews with students. The first, second, and fifth questions elicited responses about the cognitive and affective impacts of the Web-based Flash game on students' learning of colors.

During the interview, *Student A* talked about what she learned about colors from the Web-based Flash game: "I learned that the complementary color…and the yellow complementary color is purple; the purple complementary color is yellow. Blue means peaceful" [Student A, 02/12/09, one-on-one interview]. She also remarked, "I thought color

is just color before, and I haven't known the blood type" [Student A, 02/12/09, one-on-one interview]. Student A also stated, "It is fun and it has basic kits to enjoy, like the movie, and they can even be like a movie star of a color. I would tell my friends about this game" [Student A, 02/12/09, one-on-one interview].

Similarly, *Student B* remarked during the interview, "I learned like different meanings, like they can mean to different things, and each color has two to three different things" [Student B, 02/16/09, one-on-one interview]. She also stated, "I never thought things like orange can mean different things. I didn't know that before I played it" [Student B, 02/16/09, one-on-one interview]. Based on these comments, the student learned a lot about color symbolism. The student even seemed to enjoy the Web-based Flash game: "I think it is a good way to learn more about colors. I have a lot of friends interested in arts, and they might like to learn more about colors" [Student B, 02/16/09, one-on-one interview].

Student C's responses during the interview suggest that he thought he mainly learned about color symbolism from playing the game. For instance, he commented, "The movie part is funny. I did not know the blue is peace one. I did not know orange…orange is like to give a hand to help people" [Student C, 02/18/09, one-on-one interview]. Again, he remarked, "I did not know what some of the colors mean, like red is mad. I thought color has no meaning, but now I know colors have meanings" [Student C, 02/18/09, one-on-one interview]. In general, the student felt this game could help kids in learning colors: "I would introduce this to the kids because they can know colors, like what other kinds of meanings" [Student C, 02/18/09, one-on-one interview].

Student D commented, "I learned all colors…they have complementary colors, and I did not know that they had a blood type" [Student D, 02/23/09, one-on-one interview]. She

also remarked, “I though blue is sad, but it can be a good meanings. It gave me new things to know” [Student D, 02/23/09, one-on-one interview]. Furthermore, she said, “I would tell my friends. They can learn more about colors because people just think that color is color, but actually they have the meanings” [Student D, 02/23/09, one-on-one interview].

Student E commented, “I did not know red was the best friend of the purple. I understand that blue's best friend is orange. Green is the friend of yellow. And I did not know red is angry, so that is it” [Student E, 02/26/09, one-on-one interview]. He also stated, “I thought red was like love, now instead of angry” [Student E, 02/26/09, one-on-one interview]. Thus, student E appears to have learned the information about color attributes and symbolism as a result of playing the game.

During another interview, *Student F* commented, “I learned that every color has a different emotions” [Student F, 03/02/09, one-on-one interview]. She also remarked, “I did not know that emotions, like there are more emotions to a color. I thought there is only just the one. I thought red was love, but it has something like hot this kind of type” [Student F, 03/02/09, one-on-one interview]. These statements show that the student increased her knowledge about color symbolism. She also commented, “I would (introduce the game). Because a lot of my friends like pictures and like to learn the new stuff” [Student F, 03/02/09, one-on-one interview].

How do Students Engage, Persist, Express and Explore while Interacting with the Web-Based Flash Game?

Observation and Recording of On-Screen Game Play Activity

The purpose of making observations and recording the on-screen game play activity was to understand how students interacted with the Web-based Flash game and to recognize

potential challenges that might arise due to the naturalistic environment where the research activities took place. The observation and recording of on-screen game play activity took place while students explored the game independently after the short demonstration on how to play. The findings are outlined below and organized into several categories: engagement, persistence, expression, and exploration.

Engagement

Student A did not have lots of emotion changes during the game playing. Her face muscles did not flex, and her eyes looked straight ahead to the Web-based Flash game windows on the screen, and she followed along with the animated images while watching "the movie" section on the game. In addition, throughout the play Student A's eyes did not blink frequently. When the playing just begun, student A sat in the first third part of a chair with a forward-leaning body and still head, and her feet were twisted together. The chair was a little far away from a table. During play, student A maintained the posture with her left elbow bent on the desk and holding her head, and her chest was leaning on the table edge. Throughout the playing time, she sat on the first third of the chair, but she pulled the chair forward while watching "the movie" in the game.

Most of time *Student B* had a smile on her face while she played the game, and sometimes she laughed with an open mouth and wide eyes in surprise, particularly during "the movie" section on the game. She looked like she has concentrating because her eyes looked straight ahead to the windows of the game and did not turn her head to other kids who watched and called to her. Also, student B's eyes did not blink often throughout the play. In the beginning, student B sat in the full chair with a forward-leaning body, and she put her hand between thighs when she played "the star" section of the game. However, when she

moved to “the movie” section of the game, she sat straight up and leaned her chest on the table edge. She bent her left elbow and kept it flat on the desk, but sometimes brought her left arm up when she clicked the favorite colors to watch on “the movie” section. She did not let the movies play automatically in sequence; instead she clicked on what colors she wanted to watch first. When watching “the movie” section, she turned up the sound and swung her head along with the music. She nodded her head sometimes while watching.

Student C looked at the game windows with the smile on his face through the play, and laughed when he muttered, “Wow,” “Oh! Yeah,” or “Oh! What it means” during “the movie” section of the game. Besides, he looked like he was engaged with the movie content because of his nodded head. During the entire playing process, his eyes did not move away from screen, and he did not blink frequently. Student C sat in the full chair with a forward-leaning body and a still head when he was involved in “the star” section of the game. In addition, he bent his left elbow, holding his head on the desk, and he sometimes stroked his head when looked at the information about color attributes. Later, he pulled the chair forward and leaned his body on the back of the chair with his hands on his thighs while watching “the movie” section. Student C also swung his head along with the music, and very occasionally stroked his head with two hands when he was engaged in learning the color symbolism’s knowledge.

Student D did not have lots facial changes during the playtime. She looked straight ahead to the game and infrequently blinked her eyes in the beginning of the game. Occasionally, although student D stared the computer screen, her eyesight was idle. Sometimes she turned her head back to see others kids who were playing in the learning center, and throughout the playtime, she yawned several times. Student D sat in the full chair

with a forward-leaning body, but not close to the desk, and she extended her crossed legs in the beginning. Then, she changed her posture to an inclined body with her left bent elbow holding her head on the desk and her chest on the desk edge. Later, she leaned her body on the back of the chair while watching "the movie" section. She did not play the movies automatically in sequence; instead she clicked colors she wanted to watch first. Later, when she played "the lab" section, she leaned her body into the desk edge with her left arm dropped.

Student E finished the Web-based Flash game very quickly. He looked straight ahead to the computer screen, and he narrowed his eyes and blinked them occasionally while playing the game. He appeared to smile when he learned about color symbolism. Student E sat in the full chair with a slumped back, and he pulled the chair very close to the table. Most time he placed his left hand on the edge of the table. However, when he watched "the movie" section, he held his head in his left hand and sometimes brought his left arm up to stroke his head. Overall, student E was not very focused on the game, indicated by how frequently he looked at other people in the learning center.

During the game playing, *Student F* sometimes narrowed her eyes, but did not blink them very often and kept her eyesight straight toward the computer screen. She smiled while watching "the movie" section, but she pursed her lips impatiently at times when the slow Internet speed caused the movie to load slowly. When student F did a quiz in "the lab" section, she said, "Oh! Damage!" after she checked her scores of a color she selected to work on, and she challenged herself to try more colors in a quiz part. Student F leaned her body forward with a still head when she played in "the start" and "the lab" sections. Then, she sat in the full chair with a slumped back and cross-legs and stroked her face at times when she

looked at the information about basic color attributes. When she moved to “the movie” section, she sat up straight and put her hands on her thighs. During this time, she also applied lip balm two to three times. She looked very serious about watching the movie, but her body was relaxed. Still, student F did not overall pay a lot attention to the game; she constantly looked outside or at the other kids in the beginning.

Persistence

In the beginning, *Student A* went to “the star” section, and she clicked on the blue character. She spent about 40 seconds looking at the information about blue’s color attributes, and the cursor moved from the top information to the end information during this time. Then, she clicked on purple and green, but she only spent about 15 seconds on these colors. The cursor stayed on the top information (blood type, shape, and best friend) this time. Next, she went to “the movie” section, and she only watched the blue color. While watching, the cursor did not move. Following “the movie”, she went to “the lab” section. She selected the blue color and read the information that appeared on the project one carefully; however, after she read, she did not complete the project. She went to project two, and then selected blue to do the quiz. Next, she went to project three and played with the color droppers, background colors, and rotation bars. After that, she went back to “the star” section, and looked at the information about orange, blue, and purple. Then, she went to “the lab” again and selected the blue color to create a scene within project one. The total time she spent on the game was about 10 minutes (Table 5).

Table 5

Game playing time

Student	Total Time Spent on the Game (minutes)
A	10
B	19
C	26
D	20
E	5
F	18
Average	16

Student B entered "the start" section first. She looked at the content of red, orange, yellow, green, and blue in detail, as evidenced by her moving the cursor from the top to the bottom of the content presented on the information windows. She also clicked on the purple character, but she read the information quickly without moving her cursor. Afterwards, she went to "the movie" section, and she watched the movie of each color from beginning to end. Next, she entered "the lab" section. In project one, before she started, she typed her name, selected the blue color, and read the information shown in the instruction windows. After she quit project one, she went to project two and selected a few colors to do the tests. She also played with the tools in project three. The total time she spent on this game was about 19 minutes (Table 5).

Student C explored all the colors' information presented on "the start" section. He did not click on the color characters from red to purple, but instead started with the reverse order. He looked at the information about blue and purple thoroughly by his moving cursor from one entry to another. Still, he moved the cursor randomly in the information windows when he read the content of orange and red, and he didn't moved his cursor at all while looking at green and yellow. Next, he went to "the movie" section and watched all six colors in sequence by playing them automatically. Then, he went to "the lab" and started with project one. He selected orange to play. Afterwards, he entered project two and selected five colors

to do the tests. He also tried color droppers in the kaleidoscope in project three. As seen in Table 5, the total time he spent on the game was about 26 minutes.

Student D entered "the movie" section first, but after she watched the red she quit the movie section. Then, she went to "the lab" and selected the blue color to create the scene in project one. Followed by that, she did a color test in project two and explored color changes in the kaleidoscope in project three. After she left "the lab," she went to "the start" section. She also looked at the information about blue, purple, and red thoroughly by moving the cursor from one entry to another. Then, she went to "the lab" and did the three projects again. After she quit "the lab," she went back to watch the blue and purple movies and finished her play. The total time she spent was 20 minutes (Table 5).

Student E started with "the start" section, and he chose to read the red and green color attributes information. Then, he went to "the movie" section and only watched the movie for red. After that, he entered "the lab" where he did project three and skipped project one and two. Then, he quit the game. The total time he spent was about 5 minutes (Table 5).

Student F entered "the start" section first, and she looked at the content about all six colors. She read the information of red's attributes in detail, but she read the attributes of the other five colors very quickly without moving the cursor in the information windows. Then, she went to "the movie" section and watched the movies for all the colors from the beginning to the end. Afterwards, she entered "the lab," read the instructions for project one, but she skipped it and project two and entered project three. After she played project three, she went back to do project one and two. As illustrated in Table 5, the total time she spent on the game was about 18 minutes.

Expression and Exploration

In the project one of "the lab" section, *Student A* selected blue to create a scene. Within the drag props, she dragged two characters and lots of elements onto the scene. She put a hat and a crown on each character's head, and cars, rockers, and birds were scattered on the scene. Afterwards, she clicked on the draw button, and then she selected blue color and brush size. She tried to draw something on the scene, but after she drew a few lines, she deleted them. Then, she clicked quit to finish her game play. In project two, she only tried the blue color to test herself. She chose the answers carefully and then checked her scores. Next, she looked over her wrong answers after she checked the score. In project three, she first selected the green dropper and chose a pink background to see the changes in the kaleidoscope. After that, she changed to the purple dropper and a blue background. She also adjusted three rotation bars to see the changes of the rotation speed in the kaleidoscope.

Student B selected blue to create a scene in project one of "the lab" section. Within the drag props, she dragged a character and an element onto the scene. Next, she chose an umbrella and moved it to that place she wanted. Then, she clicked the draw button and selected the brush size and sky blue. She drew raindrops on the scene, and chose gray to draw the street and deep green to depict the grass. In project two, she tried blue, purple, green, and yellow to do the test. She chose the answers very quickly, and then checked the scores. She looked over her wrong answers in detail after she checked the scores. In project three, she first selected the blue dropper and used two rotation bars to see the changes in the kaleidoscope. Then, she chose the red dropper, and chose a blue and green background. After that, she tried orange with a blue background, purple with a yellow background, and yellow with a purple and pink background in the kaleidoscope.

In project one, *Student C* selected a color without reading the instruction before he entered to play. He had the difficulty to dragging a character, so he clicked the draw button; however, he stayed no more than one second and went back to the props. He succeeded in dragging a character and an element after trying a few times. Student C then switched to the draw feature and chose deep green first, but he erased it after he drew a few lines. Instead of deep green, he chose blue and pale green to draw the sky and grass. Then, he went back to the props and browsed and selected the elements that would match his scene. He also played with the character after he found he could rotate different parts of its body using the mouse. In project two, he tried red, yellow (two times), green, blue, and purple to do the tests. For all colors, he chose and checked his answers quickly, and he sighed after he found he did not answer correctly. Then he would try another color again. In project three, he used the red and orange droppers with a dark red background, yellow with a green background, blue with a sky blue and orange background, and purple with an orange background in the kaleidoscope. Then, he experimented with the rotation bars and said "Wow" when he saw the different changes and speeds in the kaleidoscope.

Student D went to "the lab" at two different times. One was before she entered "the start" section, and the other was after. In project one, the first time Student D was hesitant to select a color to play by clicking different colors' buttons before she entered the scene. She selected blue and went into the scene without reading the instructions. She dragged a character but was hesitate to choose elements she wanted to add and just browsed them back and forth. She did not select any elements. She then switched to the draw tool and chose yellow and gray. She tried to depict something using these two colors, but she failed and then quit project one.

The second time, she tried green and red to create the scenes, and she successfully dragged the characters and elements and drew lines on the scenes. She also played with the character by rotating its body parts. In addition, within project two, she selected blue at first and orange at later for tests, and she looked and chose the answers very carefully both times. After she checked her scores, she reviewed her correct and incorrect answers. Last, she also went to project three at two different times. First, she used the red, orange, yellow, blue and purple droppers with a purple background in the kaleidoscope, and she did the same thing the second time. She also played with rotation bars to see the speed changes.

Student E went to project three in "the lab." He tried all color droppers in the kaleidoscope, but he did not try background colors and rotation bars to see the different changes that appeared in the kaleidoscope.

In project one, *Student F* chose blue to create the scene. She dragged a character and two elements on the scene, and then she clicked the draw button, selected blue to draw clouds, and then quit the project. Student F chose red, yellow, and purple to do the tests in project two. She chose answers quickly, and after she checked her scores, she did not look at her results for each color. She just clicked a new color button to start the next. In project three, student F tried the red, orange, blue, and purple droppers and used three rotation bars to see the speed changes in the kaleidoscope, but she did not select any background colors.

Interview

Five open-ended questions were asked. The third and fourth questions were designed to elicit students' motivation on learning colors using the game.

When *Student A* was asked about how she felt about learning colors with this Web-based Flash game, she gave a positive response: "I like the start because it taught you the

complementary and secondary or primary or what the attitudes are" [Student A, 02/12/09, one-on-one interview]. However, she did add, "It is kind of hard if someone did not tell me how to play. I do not know where to click, and where get the place to exit" [Student A, 02/12/09, one-on-one interview].

When the researcher asked *Student B* if the game encouraged her to learn about colors, the student said, "I like the character in the movie because it shows the example, like orange means active with moving pictures" [Student B, 02/16/09, one-on-one interview]. At the same time, she stated, "Probably the movie one is difficult. Each color has different things and meanings to know" [Student B, 02/16/09, one-on-one interview].

Student C stated what attracted him about this Web-based Flash game was the third section of the game. He commented, "If it is not a game, I would just keep going to the lab because I like drag the color character and put the props" [Student C, 02/18/09, one-on-one interview]. He also said, "They are actually kind of fun because I like the things where you can make the color" [Student C, 02/18/09, one-on-one interview]. Still, student C stated, "Number one in "the lab" is kind of hard because some meanings you might need to know, some might not to know" [Student C, 02/18/09, one-on-one interview].

When the *Student D* was asked about her feelings about this web-based Flash game, she stated, "The lab is fun. I like to drag the props, and then make the scene" [student D, 02/23/09, One-on-one interview]. However, she remarked, "If you did not tell me how to play, I would not get through it. I think it needs some instruction like what this is and how to do" [Student D, 02/23/09, one-on-one interview].

Student E said about the game, "The movie was fun because I do not need to click, just watch" [Student E, 02/26/09, one-on-one interview]. He also commented, "I probably

like the star one because it tells you colors' friends" [Student E, 02/26/09, one-on-one interview]. However, he remarked, "I probably would not play if you did not show me before. I would try, but I probably would not figure out" [Student E, 02/26/09, one-on-one interview]. Besides, the student had an interesting response when asked about what difficulty he experienced while playing: "Probably the sheet (pretest) you gave because I do not really know before I play the game" [Student E, 02/26/09, one-on-one interview].

During the interview, *Student F* stated, "I like "the lab" part. You click your favorite color, and then you went to. You could drop the picture in it" [Student F, 03/02/09, one-on-one interview]. However, she said, "Doing and checking the answers in the quiz. It is a challenge" [Student F, 03/02/09, one-on-one interview].

Summary of the Major Findings

In this chapter, the results of the pretest and posttest showed that some students had little improvement on their scores in the first part of the test, which was designed to examine students' understanding of basic color attributes. That is, these students appear to have gained some knowledge about basic color attributes. Conversely, other students did not improve their scores in comparing their pretests and posttests. These students either did worse or maintained the same knowledge on basic color attributes. However, most students recognized more color symbolism after they played the game. In the pretest, some students used their imagination to describe colors, while others connected objects in their life to colors. But in the posttest, most students described colors according to the symbolism they learned from "the movie" section of the game.

Moreover, all students reacted positively to the Web-based Flash game as a way to learn about colors. In the same way, some students exhibited positive signs of engagement,

persistence, expression, and exploration during the playing time. They played the game with a smile and eye concentration, played all three sections and looked at all colors' information in the game, and played all three projects in "the lab" section. On the other hand, some students showed negative signs of engagement, persistence, expression, and exploration. They did not pay a whole lot of attention while playing the game and instead looked around the learning center sometimes, only chose a few colors to read about the information on color attributes and color symbolism, and did not explore some projects and tools in "the lab." Consequently, the next chapter discusses these findings and offers a set of suggestions for using games in teaching visual arts to elementary grade students.

CHAPTER 5. DISCUSSION AND CONCLUSIONS

This chapter provides a discussion of the findings of this study, along with conclusions, practical implications, and limitations of the study. The evaluation of the Web-based Flash game for teaching visual arts to elementary grade students not only had some cognitive and affective impact on students' learning of basic color attributes and color symbolism, but also provided information about how elementary grade students interact with a Web-based Flash game.

Discussion

According to the pretest and posttest results, elementary grade students seemed not to apparently improve their knowledge of basic color attributes after they played the Web-based Flash game. The students' knowledge of basic color attributes improved 11% on average when comparing their pretest scores with their posttest scores. Two students showed a little improvement, one student improved apparently, two did worse than in the pretest, and one maintained the same score between the pretest and posttest (Figure 4).

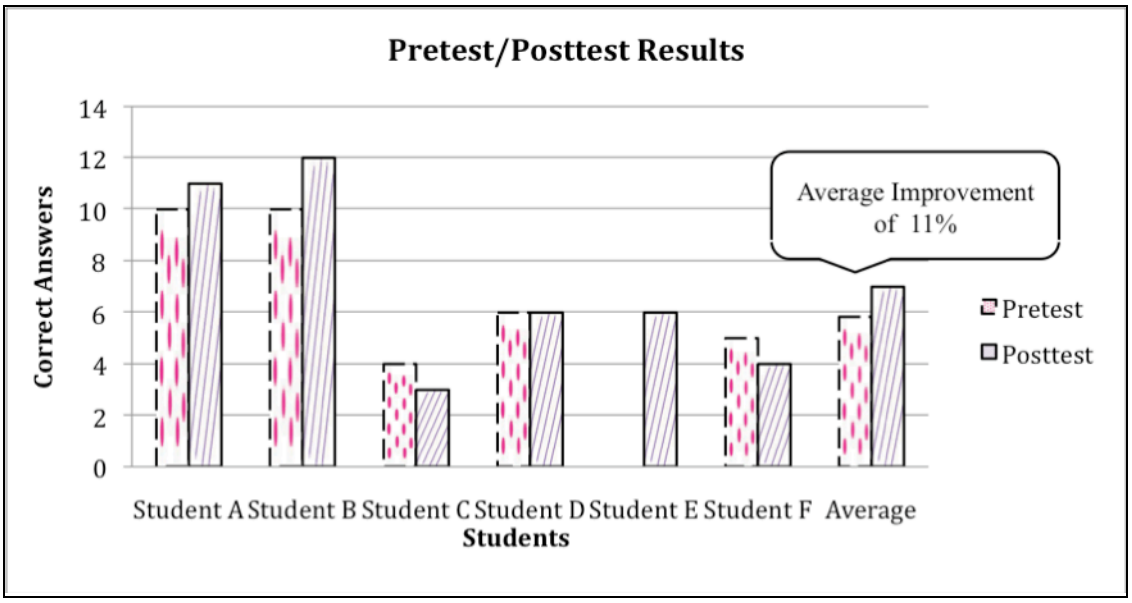

Figure 5. Pretest/Posttest result

Actually, three students truly showed progress after playing the Web-based Flash game. From the interview results, three students correctly stated that the complementary colors and blood type of colors were what they learned the most from the game. In similar research, DeKanter (2005) disclosed that students' memories are enhanced when they are physically and mentally involved in game playing. That is, using games can advance students' cognitive skills. Although three students out of six have not shown much improvement, their pretest and posttest scores slightly regressed. Jenkins (2005) revealed that players look for more information through continuous practice of using a game helps extending their knowledge in a new subject area. In this study, elementary grade students may have been able to increase their memories of colors through playing a game more than one time only.

When comparing pretest with posttest, students' cognition of color symbolism also changed from no prior knowledge to a good understanding of what color symbolism is. Students were asked to describe six colors using two to three adjectives for each color. Before they wrote down their answers in the pretest, most students asked the researcher what they needed to write down. It did appear that students did not know much about color symbolism before they played the game. In terms of pretest results, three students described these colors based on what they could observe directly from nature. Namely, they connected colors to the realistic surroundings. Although the other three students did use symbolism words to describe colors in the pretest, most color symbolism used was based on their imagination and did not correctly represent each color. Nevertheless, five out of six students wrote down the almost similar meanings or right color symbolism for each color in the posttest. Most of the words they used appeared on "the movie" section of the game.

Additionally, this game could help learners to develop imagination skill. Five students reported during the interview that they got to know the meanings of colors after playing the game. That is, these students thought that color is just a color, and they did not recognize that each color has different meanings. According to Cortés (2003), red represents active and aggressive, etc.; orange represents cheerful and creative, etc.; yellow has the meaning of bright and happy, etc.; green means adventurous and natural, etc.; blue represents cold and lonely, etc; purple has the meaning of fantastic and aloof, etc. Studying arts provides the opportunity for children to image things they cannot observe immediately (Hetland et al., 2007). Pierfy (1997) claimed that instructional games provide permanent interactive setting, apparent and consistent objectives and high-level inspiration; therefore, they can facilitate learners' organization and encoding skills. Young learners have the ability to discover, contest, collaborate and value their success when they meet the difficulty and mistakes in a game (Becker, 2007). Consequently, based on these findings, games can be the useful as an instructional strategy to teach elementary grade students if containing clear and coherent goals that attract learners to interact with.

Findings from the observations of facial expression and posture indicated that most students were highly engaged during the game playing. Four students smiled throughout the playtime, and their smiles were quite obvious while watching "the movie" section. Furthermore, all six students looked straight ahead to the computer screen, and their eyes did not blink frequently during the game playing. Namely, students truly focused on the information and movies while playing the game. From their body posture, four students sat on the entire chair and one sat on the third part of a chair, but all interacted with the game leaning their body forward and keeping their head still in the beginning of the playing. Then,

five students changed their posture while watching “the movie” section. They were either pulled the chair forward or sat straight and leaned on the table edge. Still, two of six students did not play the movie automatically in sequence, but clicked colors they wanted to watch first; two students swung and nodded their heads along with the music. Only one student sat on the full chair with slumping back from the beginning to the end of the playing. Most students showed attentive performance while playing the game. According to Amory (2006), games should be relevant, explorative, engaging and competitive to support learning while using games in education. The Web-based Flash game used in this study included five game objects of game object model, which are game space, visualization space, elements space, actor space, and problem space (Amory et al., 1999). Therefore, the findings indicate that the Web-based Flash game could be appropriate to teach elementary grade students because most students were highly engaged while playing the game, especially “the movie” section.

Based on the interview results, all students felt very positive about using the Web-based Flash game as an instructional tool to learn about colors, especially “the movie” and “the lab” sections. Three students said that “the movie” section of the game was their favorite section because it has animated images and presents the meanings of colors they did not know before. Immersing in “the lab” section was the most fun for the other three students because they enjoyed dragging and drawing in project one. However, three students reported that without the researcher’s simple demonstration of how to work within the game they might have difficulty completing the game. Therefore, the findings suggest that a game can attract students to learn new things if it provides multiple learning environments aimed at different learners. Different learners may have different learning preferences, so games should provide multiple objects rather than a linear learning environment. Furthermore,

Jenkins (2005) noted that learning is motivating when games include text, images, graphics, and animation to support multiple learners' needs. He also claimed that games should have clear goals, and players should have complete control during the game playing (Jenkins, 2005). The Web-based Flash game selected for this study contained all these features: it has "the star," "the movie," and "the lab" sections that students can choose to play in order, and each section has a different objective for learners. As a result, this Web-based Flash game has all the ingredients needed to encourage and enhance students' interests in learning basic color attributes and color symbolism.

Based on the researcher's observations and findings of on-screen game play recordings, all six students played "the star," "the movie," and "the lab" sections of the game. However, only three students demonstrated persistence within "the star" and "the movie." That is, three students looked at all six colors' attributes and symbolism shown in these two sections, while three students just selected two to three colors out of the six color attributes and color symbolism. In addition, although five students did not skip any projects in "the lab" section, one student only completed one project in "the lab." The average time spent in the game was 16 minutes. Nevertheless, there was a great difference between the longest time (26 minutes) and the shortest time (5 minutes) spent playing the game.

In addition, although all six students completed all three sections, the majority displayed more persistence playing in "the lab" section than in "the star" and "the movie" sections. One of Savery and Dufffy's (1995) constructivist principles is to anchor learning activities to a larger tasks or problem. "The lab" section of game was powerful in that it encouraged students and challenged them to learn because it contained three different tasks. In the first task, students are asked to create a scene that represents a color's meaning.

Students chose the symbolism of a color, and then checked their scores. In the last task, students applied what they learned from "the star" section by mixing and matching colors. Instructional games should set a great challenge and present score counting to motivate players, and they would keep going on playing (Jenkins, 2005). Consequently, this Web-based Flash game can help learners to succeed in the tasks and to learn the subject matter in a persistent way by offering alternative sections dealing with different sets of activities.

According to the data collected from various observations, five students actively expressed their individual ideas about using function tools in project one of "the lab" section. Specifically, four students used the drag and draw functions to create fantastic pictures. Although another student used these functions, she just dragged and moved characters and elements on the scene without really creating a coherent picture. Learning visual arts, children are able to express their thinking into artworks using art materials (Hetland et al., 2007). Indeed, this Web-based Flash game seemed to promote students' expression through delivering arts information. After students absorbed the information from "the star" and "the movie" sections, they created scenes presenting color symbolism, and mixed and matched colors in "the lab."

Additionally, all students demonstrated depth of exploration while playing in "the lab" section of game. Most students chose only one color to create the scene in project one, but they used "drag," "draw," "move," "rotate," "delete," and "erase" functions during play. Five students completed project two. Two students chose only one color to do the test, but they selected their answers carefully and reviewed their incorrect answers in detail. Three other students selected answers very quickly, and one checked her wrong answers thoroughly before she tried more colors, but the other two clicked and tried other colors without checked

on incorrect answers. All six students completed the project three. Four students explored four to five color droppers in the kaleidoscope; two students tried four to five background colors in the kaleidoscope; two students tried one to two background colors in the kaleidoscope; five students played with rotations bars, but two students did not explore background colors and one did not try the rotation bars. While playing in "the lab" section, most students not only just chose one project and one color to do, but they tried all three projects and explored the colors, tools, and tests as much as possible. Jenkins (2005) stated that games could encourage learner to test their ideas by "diving," "losing," and then "rebooting." The game examined in this study encouraged students to make mistakes and explore new ways to view things, so students in this study tried and explored more in order to challenge themselves in the game.

Comparing these findings to the results of the pilot study, the considerable differences appeared to be in the pretest and posttest and observation results. In the pilot study, two students showed a great improvement from pretest to posttest. Also, from the observations, both students in the pilot study played the Web-based Flash game thoroughly without missing any sections and projects. Therefore, the average time they spent on the game play was 24 minutes. However, when the study was carried out in a naturalistic setting, the findings were not similar to the pilot study. Half of the six students made little progress when comparing their pretests and posttests, and the other half students did worse or maintained the same score. Moreover, in their game playing only a half of the six students demonstrated persistence during play. The researcher assumes that several factors may have caused these differences between the findings of the pilot study and the formal research. Students in the after-school club were different ages and in different grades, and some of them might have

been naturally more interested in art and already had a little prior knowledge about colors. Moreover, the environment they were located in while playing had noise and disturbances, so these students' learning intentions and attention might have been distracted. For example, at the after-school club most students gathered in games room and the gym to play and exercise, the learning center broadcasted music, and many club members and staff chatted, played, and watched television here. Hence, students might have tried to finish the game as soon as possible in order to join the club's many other activities. Conversely, the pilot study took place in a lab setting reserved for this study exclusively. Participants were not disturbed by other unnecessary people, activities, and environments, perhaps causing them to focus more fully on the game.

Conclusions

This study evaluated a Web-based Flash game called "Color in Motion" to identify the cognitive and affective impact on elementary students' learning of colors. Games integrated into instruction should be selected carefully, and the instructional content and the game interfaces should be considered when make the decision. According to Amory (2006), games should have relevant, explorative, engaging, and competitive features to support authentic learning when they are used in education. Therefore, in order to achieve the best learning results, instructors planning to use games as an instructional tool should evaluate games before implementing them in the classroom setting.

Based on previous findings, a Web-based Flash game used to teach elementary grade students has the potential to promote both students' cognitive skills and learning motivation. In the same way, this study suggested that the "Color in Motion" game has a positive influence on increasing elementary students' motivation on learning about arts. However,

persistence of game play in the study was deficient. Moreover, the findings pointed out that students did not have notable improvement on the understanding of basic color attributes, but they did recognize more color symbolism after they played the game. Although the findings revealed that some students did not play the game thoroughly in the after-school club, the results of the pilot study showed students could persist in playing in the lab setting. Therefore, without persistence, students could not answer well in the posttest. Jenkins (2005) also disclosed that students need continuous play to help them encode the knowledge. Improvements in the research design will be needed to further evaluate the game.

Practical Implications

The results of this study are enlightening but hard to generalize to a larger population because of the research approach, small sample size, and individual differences among participants. Nonetheless, the findings of this study indicate that games have a promising future in teaching arts for elementary grade students who are raised in an era overflowed with computer and video games.

Based on the findings of the study, the students' cognition of basic color attributes did not show great improvement after playing the Web-based Flash game. Only two students got really high scores on the pretest, but the other four students did poorly in the pretest. According to the posttest results, only one of four students who performed poorly in the pretest progressed greatly; one kept the same score; two scored lower. One reason for these results might be the extensive content covered in the game about color attributes for each of the colors, so it was difficult for students who did not have prior knowledge about colors to understand all the information at once. "The star" section of the game provided much information for each color. This abundant information might cause elementary grade students

to lose interest in reading small-font texts within a limited playing time. For instance, one of the students read the content of basic color attributes fully for the first color, moving her cursor from the top to bottom of the text. However, when she clicked on a second color, she read and closed the information window rapidly without any cursor movement. It appeared that elementary grade students do not have the patience to persist reading the content for each of the six colors. Eisenlauer and Hoffmann (2008) claimed, "the medium is the text design and text design shapes the message" (p. 15). Text design is an important factor of multimedia design because an appropriate text design builds visual cohesion, so text acceptance is embedded when the reader is motivated to find semantic relations on the original text (Eisenlauer and Hoffmann, 2008). Consequently, text design of the Web-based Flash game should be considered when the game is designed for children at the elementary level.

Students' persistence of the game playing was lacked, and the results might due to the environment setting. Within the after-school club, learning about and playing with this Web-based Flash game was not their first intention while they were there, and they faced a number of distractions: friends talked to several participants occasionally while they were playing the game, some participants were called to do this research activities while playing basketball or other games, and others looked around at what other activities were taking place in the learning center while playing the game. After they finished game playing, they continued their previous activity or joined a new activity right away. Accordingly, a learning environment where students only concentrate on their learning subject could lead to different results of their persistent playing. Though, high engagement, expression, and exploration were appeared while playing the Web-based Flash game in the after-school club. Participating students actively participated in this study and played the game without a force

from other people. Besides, other children in the club also curious about the Web-based flash game. Specifically, when the researcher was setting up the game before each research activity, some children asked the researcher about the game and wanted to play. Some children surrounded participants and watched the game playing process together. The Web-based Flash game indeed attracts children's eyes and their playing intentions. Furthermore, the after-school club is an informal learning environment where children learn skills and knowledge through informal ways, such as watching movies and playing basketball, etc. Not only do children have entertained by these activities, but also have learned things unaware. Therefore, since the Web-based Flash is an informal learning material, a study was conducted in the informal learning environment. A learner-centered learning is trying things actively and giving the action, not more focuses on knowledge memorizing. Playing the Web-Based Flash game in the after-school club could understand if students could be motivated to look for the information about the subject matter through playing the game under a relaxed setting. Based on the findings, students were highly motivated, so the after-school club is a great resource for children to develop their learner-centered learning. Likewise, the after-school club is a valuable community resource for institutions because it helps children catch up and keep up before they study the new subject matter in their school classrooms.

This study suggests that games, as instructional tools have specific characteristics that allow students to actively develop their ideas, higher order thinking, problem solving, and reflection skills. Not only do games facilitate students' learning as a learning media, but they also play an important role in combining instructional content and authentic task-based learning environments so teachers can use them as teaching materials. Consequently, how to

use games in learning environments should be considered. Games usually contain complex tasks, so it is difficult to enhance students' learning without repeated play. Elementary students' cognition skills and performance might have great improvements when they access the same game repeatedly, but this study gave students only one chance to play the game. Moreover, although all students reported they were highly motivated to learn the colors using the game, they might think their game playing was for a study, so they only gave positive responses about the game. As a result, it is not clear if they truly liked playing the game to learn about colors, so in future research students should reflect on their feelings and thoughts with their peers and activity facilitators in more natural way after playing the game.

This study emphasized the interaction between the game and the student, so further research may want to focus more on interactions among games, students, and activity facilitators. Implementing games in the elementary school classroom will be practical if this model can be used to identify games' effects. An activity facilitator can introduce the relevance of learning visual arts to students first and give facilitation what information and activities are in the game. Then, activity facilitators could demonstrate how to play the game to have the most fun. Through the interaction with the game, students can develop the skills of reading colors' meanings and attributes, so they can use harmonious colors to make meaningful artworks based on colors' symbolisms and attributes. In addition, students can reflect and discuss their creations with their classmates and activity facilitator together, so they have the chance to understand others' thoughts about color. Consequently, the Web-based Flash game may help students construct their visual reading skills and express their ideas into concrete drawings through guided activities. In this way, elementary grade students may gain unexpected learning benefits when interacting with the game, peers, and an activity

facilitator. In terms of the findings of this model, schoolteachers may be more willing to integrate a game into their instruction. Teachers and students can both facilitate their arts teaching and learning through this emerging computer supported learning.

Limitations of the Study

This study met a major challenge: participants in this study would not come from similar educational backgrounds. These participants were volunteered and recruited from an after-school club in which members are in different grades and ages and may be educated in different ways by their teachers. Consequently, these participating students and the findings of this study cannot be representative for all elementary grade students, ages 10 to 12. The purpose of this study was to understand the cognitive and affective impact of the Web-based Flash game on elementary grade students' learning; therefore, instead of generating and representing the results to all children ages 10 to 12, it provides findings that suggest that the game could have a positive impact on elementary grade students' learning in some degree.

The other challenge encountered in this study was that this study was conducted in an after-school club, so there was not an activity facilitator to explain the relevance of the games' learning subject to the students. According to Keller (1987), goal orientation, motive matching, and familiarity are three strategies to help make learners aware the value of the topic. That is, an educator should provide relevance to encourage students to have constructive feelings about the materials. As a result, students might not fully engage and persist in playing a game without an activity facilitator's facilitation. For this reason, this study's participating students might not have taken learning seriously while playing the game.

Furthermore, the validity of the pretest and posttest results might be threatened because students were given one time to play the game, and after the limited playing time students took the posttest right away without any chance to playing the game again. The researcher was not involved in long-term research with participants and only carried out the research activities once for each participant. Namely, students could not play the Web-based Flash game repeatedly to strengthen their memory about color knowledge before they answered the posttest. Another challenge was that this study used an interview to gather participants' feelings and perceptions about learning from the game. Besides, students were not familiar with the researcher, so there may be discrepancies of perspectives between actual use and self-report (Wimmer & Dominick, 1994). Consequently, the results of the interview may be unreliable because participants might not open up and share their real thoughts with a person they did not know well.

APPENDIX A. PRETEST/POSTTEST

Student Code:
Warm up exercise, Have Fun & Enjoy!
Part 1: (Please fill in the answer for each question.)

1. The blood type of color red is _____
2. The complementary color of red is _____
3. The blood type of color yellow is _____
4. The complementary color of yellow is _____
5. The blood type of color green is _____
6. Color green is mixed by _____
7. The blood type of color violet is _____
8. Color violet is mixed by _____
9. The blood type of color orange is _____
10. Color orange is mixed by _____
11. The blood type of color blue is _____
12. The complementary color of blue is _____

Part 2: (what symbolism do you think each color stands for below? Please describe each color using 2 to 3 adjectives)

 _____  _____

 _____  _____

 _____  _____

APPENDIX B. OBSERVATION GRID

Student Code:
Observation date & time:

- Context:

- Student shows curiosity on his or her facial expression:

- Student is actively engaged in the game:

- Student plays the game from beginning to the end without missing any segments:

- Student produces many unique images while playing in the interactive activities section:

- Other:

APPENDIX C. INTERVIEW GUIDE

Student Code:

1. What have you learned about colors from this web-based flash game? Does this game need improvement to help you better understand about colors? If yes, what are they? And how you will change this game?

2. Do you think about colors differently now that you played with this game? Give an example of your thinking.

3. Which part of the game motivates your interest in learning about colors? Why?

4. What were the most fun moments while you played the game? What were the most difficult things for you throughout the play?

5. Overall, would you show this web-based flash game to your friends as a way to learn about colors? Why? Or Why not?

BIBLIOGRAPHY

Abrahmov, S. L., & Ronen, M. (2008). Double blending: online theory with on-campus practice in photography instruction. *Innovations in Education and Teaching International*, *45*(1), 3–14

Adler, E. S., & Clark R. (2008). *How it's down: An invitation to social research.* CA: Thomson Wadsworth.

Americans for the Arts. (2007). *Arts education: K-12 arts education policy.* Retrieved February 11, 2008, from http://www.americansforthearts.org/information_services/research/impact_areas/arts_education/002.asp

Americans for the Arts. (2007). *Community arts education project.* Retrieved February 11, 2008, from http://www.artsusa.org/information_services/arts_education_community/resource_center_003.asp

Americans for the Arts. (2006). *Issue Brief: Arts instruction of public school students in the first and third grades.* Retrieved February 11, 2008, from http://www.americansforthearts.org/NAPD/modules/resourceManager/publicSearch.aspx?id=12438

Amory, A. (2007). Game object model version II: A theoretical framework for educational game development. *Educational Technology Research and Development, 55*(1), 51-77.

Amory, A., Naicker, K., Vincent, J., & Adams, C. (1999). The use of computer games as an educational tool: 1. Identification of appropriate game types and game elements. *British Journal of Educational Technology, 30*, 311-322.

Astleitner, H. (2005). Principles of effective instruction--General standards for teachers and instructional designers. *Journal of Instructional Psychology, 32*(1), 3-8.

Braden, R. A. (1996). Case for liner instructional design and development: A commentary on models, challenges, and myths. *Educational Technology, 36*(2), 5-23.

Becker, K. (2007). Digital game-based learning once removed: Teaching teachers. *British Journal of Educational Technology, 38*(3), 478-488.

Bonanno, P., & Kommers, P. A. M. (2008). Exploring the influence of gender and gaming competence on attitudes towards using instructional games. *British Journal of Educational Technology, 39*(1), 97-109.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: brain, mind, experience, and school.* Washington, D.C.: National Academy Press.

Cameron, B., & Dwyer, F. (2005). The effect of online gaming, cognition and feedback type in facilitating delayed achievement of different learning objectives. *Journal of Interactive Learning Research, 16*(3), 243-258.

Catterall, J. S., & Peppler, K. A. (2007). Learning in the visual arts and the worldviews of young children. *Cambridge Journal of Education, 37*(4), 543-560.

Cortés, C. (2003). *Color in motion.* Retrieved March 10, 2007, from http://www.mariaclaudiacortes.com/#

DeKanter, N. (2005). Gaming redefines interactivity for learning. *TechTrends: Linking Research & Practice to Improve Learning, 49*(3), 26-32.

Dimitrov, D.M., & Rumrill, P. (2003). Pretest-posttest designs in rehabilitation research. A *Journal of Prevention, Assessment, & Rehabilitation, 20*(2), 159-165.

Eisenlauer, V. J., & Hoffmann, C. R. (2008). The metapragmatics of remediated text design. *Information Design Journal, 56*(1), 1-18.

Fitzpatrick, J. L., Worthen, B. R., & Sanders, J. R. (2003). *Program evaluation: Alternative approaches and practical guidelines.* Boston: Allyn and Bacon.

Gee, J. P. (2004). *Language, learning, and gaming: A critique of traditional schooling*. New York: Routledge.

Glesne, C. (2006). *Becoming qualitative researchers: An introduction.* Boston: Allyn and Bacon.

Hetland, L., Winner, E., Veenema, S. & Sheridan, K. M. (2007*). Studio thinking: The real benefits of arts education.* New York: Teachers College Press.

Jenkins, H. (2005). Getting into the game. *Educational Leadership, 62*(7), 48-51.

Joseph, A. (2002). *The value of the arts to the community and education*. Retrieved November 16, 2007, from http://www.newhorizons.org/strategies/arts/joseph.htm

Johnson, M. H. (2008). Developing verbal and visual literacy through experiences in the visual arts. *Young Children, 63*(1), 74-79.

Keller, J. M. (1987). Strategies for stimulating the motivation to learn. *Performance and Instruction, 26*(8), 1-7.

Kirkley, S. E., & Kirkley, J. R. (2005). Creating next generation blended learning environments using mixed reality, video games and simulations. *TechTrends: Linking Research & Practice to Improve Learning*, *49*(3), 42-54

Koster, R. (2004). *A theory of fun for game design.* Scottsdale, AZ: Paraglyph Press, Inc.

Kytta M., Kaaja, M., & Horelli L. (2004). An Internet-based design game as a mediator of children's environmental visions. *Environment & Behavior, 36*(1), 127-151.

Maxwell, J. A. (2005). *Qualitative research design: An interactive approach.* CA: Sage Publications, Inc.

Northwest Educational Technology Consortium. (2005). *What does research tell us about online education.* Retrieved February 11, 2008, from http://www.netc.org/digitalbridges/online/essentials/research.php

Papert, S. (1993). *Mindstorms: children, computers, and powerful ideas.* New York: A Division of HarperCollins Publishers, Inc.

Pierfy, D.A. (1977). Comparative simulation game research: Stumbling blocks and stepping stones. *Simulation and Games, 8*(2), 255-268.

Resnick, L. (1987). Learning in school and out. *Education Researcher, 16*(9), 13-20.

Scholastic Testing Service. (2007). *Torrance test of creative thinking (TTCT).* Retrieved August 25, 2008, from http://www.ststesting.com/2005giftttct.html

Savery, J., & Duffy, T. (1995). Problem-based learning: An instructional model and its constructivist framework. *Educational Technology, 35*, 31-38.

Thibodeaux, T. (2001). Gaming: The first CE contact. *Dealerscope: The Business of CE Retailing, 3(*43), 42.

Warburton, E. C. (2006). Access to arts beyond high School: Issues of demand and availability in American higher education. *Arts Education Policy Review, 107*(6), 11-1.

Wimmer, R. D. & Dominick J. R. (1994). *Mass media research: An introduction*. (8th Ed.), California: Wadsworth

ACKNOWLEDGEMENTS

This project would not have been possible without the support of many people. Many thanks to my major professor, Dr. Ana-Paula Correia, who read my numerous revisions and helped me make sense of the confusion. Most importantly, she challenged and guided me in the right direction not only for this project but also in how to conduct research. Also, thanks to my committee members, Dr. Ann D Thompson and Dr. Paul Bruski, who offered guidance, assistance and support. Finally, I would like to take this opportunity to express my thanks to my parents, Rong-Can Yang and His-Ming Chen, who support and encourage my decision all the way and provide me the better life without worry. It is their support that helped me to develop the drive I needed to succeed in life. Without them, I could never have successfully completed this project.