FACILITATING LEARNING TRANSFER THROUGH STUDENTS' SCHEMATA

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A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

Capella University

November 2007

Abstract

Students' enculturation into a media-rich environment has influenced both their social practices as well as their cognitive processes, resulting in what this study refers to as new social and cognitive-connectedness schemata (SCCS). This study examined how and to what extent online instructional strategies that facilitated students' SCCS affected learning transfer in three middle school classes. The results of the study indicated that SCCS instructional strategies narrowed the gap between lower and higher performing students, and significantly increased students' learning transfer abilities. It also showed that correlations exist between the use of expertise structures and the facilitation of students' social and cognitive-connectedness schemata. These results suggest the articulation of a new theory of learning based on students' social and cognitive-connectedness schemata, and a new instructional design model that incorporates these schemata changes.

Dedication

This study is dedicated to Mark, my husband and my best friend. He believed in me when I even lost faith in myself. He put up with a messy house and TV dinners, calmed my occasional panic attacks, and rejoiced with me in my triumphs. I couldn’t have run this race without him running by my side.

Acknowledgments

While completing my undergraduate studies I ran across the ancient proverb, “A wise teacher makes learning a joy; a rebellious teacher spouts foolishness.” The day I read this proverb I vowed to learn how to make learning a joy, and how to avoid spouting foolishness. Here I am, 32 years later, still trying to discover the best ways to make learning a joy. With the help and dedication of my mentor, Dr. Elena Kays, and the consistent nudgings for greater clarity from Dr. Rod Sims and Dr. Amy Kuo-Newhouse, this research has brought me closer to my goal of making learning a joy. I also want to acknowledge the pioneering work of Dr. Kip Leland in developing the interface for the online virtual world (KaMOO) used in this study, and to thank her for mentoring me in my efforts to create a new digital space called the *Aeneid* Rome KaMOO.

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CHAPTER 1. INTRODUCTION

Introduction to the Problem

Enculturation into a media-rich environment has influenced both the social practices as well as the cognitive processes of those who find themselves immersed in it (Shumar & Renninger, 2002). As a result, those who have grown up in the digital age have developed “new and different types of schemata” (Pillay, 2003, p. 336). A review of the literature affirms the existence of these changes, but falls short of naming or providing constructs of these new social practices and cognitive processes. This study refers to the development of these new structures as social and cognitive-connectedness schemata (SCCS). In order to effect greater learning transfer, designs for both traditional and online instruction need to take into account these changes. The study examined how and to what extent online instructional design strategies that facilitate students’ social and cognitive-connectedness schemata will affect learning transfer in K-12 education.

The interactive and interpersonal applications of digital technology, such as the use of Weblogs, instant messaging, text messaging, online games, and other media forms have impacted the social and cognitive schemata of those who use them (Shumar & Renninger, 2002). Oblinger (2004) claimed that students’ “constant exposure to the Internet and other digital media has shaped how they receive information and how they learn” (¶1). The March 2005 Kaiser Family Foundation Study, based on a nationally representative survey of 3rd-to 12th-grade students, concluded that students' media exposure contributes in important ways to their cognitive and social development. "The amount and nature of media exposure plays an important role in what children and adolescents know, believe, and value" (Kaiser Family Foundation Study, 2005). The research of Nisbett, Peng, Choi, and Norenzayan led them to conclude that "the considerable social differences that exist among different cultures affect. . . the nature of their cognitive processes (2001). Instant digital communication has accelerated, broadened, and altered students' cognitive and social interactions on a scale unmatched by any previous technology. In order to better facilitate transfer, instructional strategies need to take into account the development of these new social and cognitive-connectedness schemata (Morrison, Ross, & Kemp, 2004; Lupart, Marini, & McKeough, 1995).

Background of the Study

The digital lifeworlds inhabited by today's younger students differ significantly from those of their parents and grandparents. According to Agre and Horswill (1997), a lifeworld is the patterned ways in which an environment gives meaning to a specific group within a particular activity. Lifeworlds contain tools that are "arranged in the world in ways that simplify life and reduce the cognitive burden on individuals" (Agre & Horswill, p. 114). The digital tools available to today's students have changed their lifeworlds, providing them new affordances. Gibson (1986) used the term "affordances" to describe the relationship between these tools and a person's lifeworld. Gibson defined an affordance as "something that refers to both the environment and the animal in a way that no existing term does" (p. 127). It "implies the complementarity of the animal and the environment" (Gibson, p. 127). Agre and Horswill illustrated the connection between affordances and lifeworlds by explaining, "a kitchen affords a different kind of lifeworld to a chef than to a mechanic, though clearly these two lifeworlds may overlap" (p. 114). How people perceive the affordances of their lifeworlds determines how they utilize their environment. The digital lifeworlds of today's coexisting generations overlap. However, as the Literature Review in Chapter 2 shows, the way today's students utilize these technologies has fostered the development new social and cognitive-connectedness schemata. This study proposes that targeting constructs of learners' SCCS can effect greater levels of learning transfer than instructional strategies that do not target these constructs.

Social-Connectedness Schema

A schema is the basic unit of knowledge representation, as well as a procedure used to scan new input to see if it has information relating in some way to a previously understood concept (Rumelhart & Norman, 1981). A schema is a structure "for understanding a problem situation in general terms, as well as guiding problem-solving performance" (Anderson, Greeno, Kline, & Neves, 1981, p. 206). Constructs of students' new social-connectedness schema include students' preferences to link, lurk and lunge (Brown, 2000). Students link up with others who have the digital knowledge they would like to obtain. They lurk, or observe the expertise of others, and then lunge, eagerly jumping in to try new things, often in preference to reading a manual.

Today's students link up with others who have similar interests. Over a three-year period, Yee (2005) collected data from over 30,000 users of Massively Multi-User Online Role-Playing Games (MMORPGs). He found that what draws millions to engage in MMORPGs is its highly social nature. As of January 2006, the number of worldwide massively multiplayer online game subscribers totaled over 13,000,000 (Woodstock, 2006). The high number of gaming subscribers is one indication of students' new social-connectedness schema. An example of online players' preference to link is the fact that many acquire items such as virtual equipment, clothing, and weapons as they progress through their games, and then trade them online through auctions such as eBay. "Norrath, the setting for the online game EverQuest, has been found to be the 77th richest country in the world, sandwiched between Russia and Bulgaria. . . . Norrath has a gross national product per capita of $2,266, bigger than China and India" (Lichtarowicz, 2002, ¶2, 4). The fact than a virtual country has a GNP greater than the physical countries of China and India is an indication of the extensive linking activity engaged in by today's Net generation. In addition to online gaming, other technology-related activities also evidence students' new social-connectedness schema. For example, in 2003, the estimated number of worldwide instant messaging users was 258 million, with a predicted growth of over 510 million in 2007 (Radicati, 2003). More than 50 million iPods have been sold since their introduction in 2001. Eight million of those were sold in the quarter ending April 1, 2006 (Welte, 2006). These figures, when combined with the number of cellular phone calls, emails and Web sites accessed on a daily basis, underscore the

Net Generation's ability and preference to link up with others in ways not previously imagined.

A second construct of students' social-connectedness schema is their desire and ability to lurk; to watch others who know how do to what they want to do. "Today's kids get on the Web and link, lurk, and watch how other people are doing things, then try it themselves" (Brown, 2000, p. 14). Over 50% of the respondents in Yee's MMORPG surveys believed that their multi-player gaming experiences had improved their real-life leadership skills (2005). They believed that their face-to-face skills had improved through their observation and interaction with others in an online environment. The Internet is ideally suited for the implementation of a learning ecology that provides students with opportunities to lurk – to learn by watching and interacting with others.

A third construct of students' social-connectedness schema is their desire and ability to lunge; to eagerly jump in and try new things. Brown (1999) explained:

> My generation, speaking generally, tend not to want to try things unless we already know how to use them. If we don't know how to use some appliance, software or game, etc., then we tend to reach for a manual, ask for a training course or ask to be shown how to do it by an expert. Believe me, hand a manual to a 15-year-old or suggest going to a training course and he thinks you are a dinosaur. "A manual? Give me a break! Let me get in there and muck around and try various things and see what works." (¶25)

Given this shift in social connections, this study examines how and in what ways instructional strategies that target students' social connectedness schema and its constructs of link, lurk, and lunge facilitate transfer when compared with strategies that do not target these constructs.

Cognitive-Connectedness Schema

In addition to using a social-connectedness schema, an analysis of the literature shows that today's students also employ a cognitive-connectedness schema when receiving new input. Students want to know how their learning connects to the larger picture. As Brown, Collins and Duguid (1989) pointed out, the Net Generation has both the ability as well as a need to see knowledge not as separate bits of information, but as having "constituent parts [that] index the world and so are inextricably a product of the activity and situations in which they are produced" (¶11). Students' ability and need to connect to the larger picture describes their cognitive-connectedness schema, and includes three structures: navigation literacy, a preference for interactive, discovery-based learning, and the ability to make reasoned judgments based on a plethora of resources (Tapscott, 1998; Brown, 1999).

The cognitive-connectedness constructs of navigation literacy, a preference for interactive, discovery-based learning, and the ability to make reasoned judgments can be summed up in Lévi-Strauss' term *bricoleur* (1996). The affordances of today's technologies encourage the development of *bricoleurs.* Lévi-Strauss explained that, in its old sense, the French verb *bricoler* applied to "some extraneous movement: a ball rebounding, a dog straying or a horse swerving from its direct course to avoid an obstacle" (p. 16). Lévi-Strauss has used the term *bricoleur* to refer to a person who is:

> adept at performing a large number of diverse tasks. . . . always to make do with "whatever is at hand," that is to say with a set of tools and materials which is always finite and is also heterogeneous. . . . the contingent result of all the occasions there have been to renew or enrich the stock or to maintain it

with the remains of previous constructions or destructions. (p. 17)

Erik, a middle school student, provides a good example of a *bricoleur.* Erik received an assignment to create a science report on renewable resources, so he decided to present his information in an iMovie. First, he conducted a Google search and found a list of specific renewable resources such as oxygen, fresh water, timber, and biomass. This list also included links to images. He reviewed the images and then downloaded them to a folder on his desktop. He remembered that he already had a digital image of the Sacramento River from his family's vacation last summer, so he added a copy of that picture to his folder. Conducting another Web search, he gathered statistics about biofuels from the National Renewable Energy Laboratory Website. He then located and downloaded a video clip of a boy chopping down a tree. An Alta Vista audio search helped him find an MP3 sound of running water. Next, he word-processed a script about the information he had gathered, and then recorded a narration of this script with a sound-editing program. Finally, he compiled all of these materials in iMovie, adding an upbeat, original music track that he had previously created in Garage Band. In terms of Lévi-Strauss' *bricoleur,* this student made use of what was "at hand"; tools and online materials that were finite and unrelated to each other. The inclusion of his river picture and music track utilized previous "constructions." His ability to combine all of these materials displayed his cognitive-connectedness schema constructs of navigation literacy, his preference for discovery-based learning, and his capacity to make reasoned judgments based on a plethora of resources. Erik is a prime example of a *bricoleur.*

While the term *bricolage* incorporates all three constructs of students' new cognitive-connectedness schema, navigation literacy is one of its primary attributes. Brown (2000) defined navigation literacy as "the ability to be your own personal reference librarian – to know how to navigate through confusing, complex information spaces and feel comfortable doing so," (p.14). Brown added that this "may well be the main form of literacy for the 21st century" (p. 14).

In addition to navigation literacy, a second construct of b*ricoleurs'* cognitive-connectedness schema is a preference for interactive or discovery-based learning. For example, a 2004 survey of 8 to 18-year-olds indicated that they spent 5% less time watching television and 5% more time on computers than those surveyed in 1999 (Kaiser Family Foundation Study, 2005). As Darla Crewe, a 16-year-old interviewed by Tapscott (1998) stated, "I like the Internet more [than TV] because. . . it's a way to educate yourself about the things that interest you" (p. 79). The more students participate in interactive and discovery-based learning environments, the more proficient they become in extending their knowledge base. This increased knowledge base enables learners to bring even more details into their peripheral reach without experiencing information overload. As Pea (1985) wrote, "Intelligence is not a quality of the mind alone, but a product of the relation between mental structures and the tools of the intellect provided by culture" (p. 168). The interactive digital tools of today's culture have helped students develop a cognitive-connectedness schema.

In addition to students' navigation literacy and preference for interactive and discovery-based learning, today's digital tools have also helped students develop an ability to make reasoned judgments based on a plethora of resources. The process used by Erik to create his science presentation illustrates this third cognitive-connectedness construct. First, Erik opened a word-processing program to take notes on the information that he gleaned from the National Renewable Energy Laboratory Website. With this word-processing window still open, he surfed the Internet to locate the video of a boy chopping down a tree, and the MP3 sound of running water. He downloaded these files to his desktop, making notes in his word-processing document about how he might use these downloads in the final presentation. He then opened a second word-processing document and composed a script. With his script still visible, Erik opened a sound-editing program and recorded his narration using his computer's built-in microphone. Erik then saved the script's soundtrack as a Quicktime file and imported it into iMovie. Next, he imported his previously recorded Garage Band music track, his video, and his images into his iMovie. Finally, he sequenced his video and images to fit with his narration. As the process Erik used to create his science project shows, an "enhanced peripheral reach increases our knowledge and so our ability to act without increasing information overload" (Weiser & Brown, 1995, ¶13). This ability to have an increased peripheral reach without experiencing information overload allows students to make reasoned judgments utilizing an array of resources.

Trying to make use of such an extended knowledge base overwhelms many adults. K-12 students, however, seem to thrive on it. Tapscott's research (1998) led him to conclude that "N-Gen children are born with technology, they assimilate it. Adults must accommodate – a different and much more difficult learning process. With assimilation, kids view technology as just another part of their environment" (p.

40). Today's students must focus on the most salient data in their extended knowledge base in order to make informed decisions about what information they will assimilate, what information they will store, and what they will choose to ignore. A scene from a typical MMPOG (massive multiplayer online game) provides a good example of students' ability to make these kinds of reasoned judgments within digital spaces. A good MMPOG player learns to swap the periphery of the game for the center, and then back again, when necessary. The center of a game screen might show a player's character, acting in concert with other members of his guild, as they attack an over-sized monster. A novice player focuses on his character, and the best way to use his limited resources to inflict lethal blows. A skilled player, however, swaps the periphery for the center, noticing at the edge of the screen how players are bartering for magical swords, avatars, and other objects of play in order to mount a more cooperative strategy to defeat their common foe. "The real game is deeply social. . . . The real action lies in the new kind of nonlinear, multiauthored narrative being constructed collectively by the players" (Brown & Gray, 2003, ¶ 26).

The affordances of today's technologies, the ways students interact with and are changed by their digital worlds, have fostered the development of a cognitive-connectedness schema. This cognitive-connectedness schema includes the constructs of navigation literacy, a preference for interactive/discovery-based learning, and an ability to make reasoned judgments based on a vast array of resources.

SCCS and Transfer

Campione, Shapiro, and Brown (1995) pointed out that transfer occurs when students have the opportunity "to explain the resources (knowledge and processes) they are acquiring and to make flexible use of them" (p. 38). Erik's renewable resources project gave him the opportunity to explain his knowledge of renewable resources to his classmates because the assignment allowed him to use his cognitive-connectedness schema construct of discovery-based learning. The assignment also allowed him to employ his navigation literacy in order to collect the information. Erik had acquired most of his knowledge about compiling resources and creating his project through interaction with his peers, making use of his social-connectedness schema. The final form of his project, the iMovie, allowed him to make flexible use of this knowledge and these processes. As shown in this example, instructional strategies that invoke the use of students' SCCS will provide students with opportunities to employ their navigation literacy and preference for discovery-based learning. These strategies will also give students opportunities to make judgments about what resources and processes they need to acquire for specific projects, and how they will reassemble these resources in order to share their new-found information with others.

In conclusion, the affordances of today's technologies have effected changes in students' social and cognitive-connectedness schemata. The formation of new social and cognitive-connectedness schemata calls for instructional design strategies that reflect these changes. Reigeluth (1999) stated that new instructional design theories and models are needed in response to the "advances in information technologies, which have made new methods of instruction both possible and necessary" (p. ix). He urged designers to develop theories and models that "subsume current theory and offer flexible guidelines" (Reigeluth, p. 20).

Statement of the Problem

It is not sufficiently known how and to what extent online instructional design strategies that facilitate social and cognitive connectedness schemata will affect learning transfer. It is known, however, that schema acquisition provides an explanation of expert performance (Sweller, Chandler, Tierney, & Cooper, 1990). Since a relation exists between learning transfer and expert performance (Glaser & Chi, 1988), a comparison between an instructional design that facilitates schema acquisition and one that does not can provide some measure of how and to what extent the facilitation of schema acquisition affects learning transfer.

Purpose of the Study

The purpose of this study was to examine how and to what extent online instructional design strategies that facilitate students' social and cognitive-connectedness schemata would affect learning transfer in K-12 education.

Research Question

How and to what extent will online instructional design strategies that facilitate students' social and cognitive-connectedness schemata affect learning transfer in K-12 education?

Hypothesis

Instructional design strategies that facilitate schema acquisition will increase levels of learning transfer.

Significance of the Study

The North Central Regional Educational Laboratory (2002) stated, “Optimal resource configurations and instructional design practices that promote effective e-learning outcomes in K-12 learning environments currently are not recognized, generally understood, or agreed upon by e-learning producers, consumers, and education policy leaders” (p. 9). Schaller and Allison-Bunnell (2003) have suggested that we are in a “pre-paradigmatic phase of learning style research. The blind researchers have each described a different part of the elephant, but have not yet synthesized their findings into a picture of the whole beast” (p. 3). Instructional researchers and designers need a more complete picture of “the whole beast” in order to promote more effective e-learning outcomes.

Learning theories such as behaviorism, cognitivism, constructivism, situativity, and situated cognition all describe parts of the elephant. No learning theory exists relating the development of students’ social and cognitive-connectedness schemata to the affordances of today’s technologies. A review of the literature, however, presents evidence that students’ immersion in today’s digital lifeworlds has promoted the development new social and cognitive-connectedness schemata. If such a relation exists, and if a relation can be established between SCCS-based instructional strategies and increased learning transfer, it will warrant further research toward developing a learning theory based on students’ social and cognitive-connectedness schemata. As Reigeluth (1999) noted,

> A good instructional designer knows theories of learning and human development. Indeed, learning and development theories are useful for understanding why an instructional-design theory works, and, in areas where

> no instructional-design theories exist, they can help an educator to invent new methods or select known instructional methods that might work. (Reigeluth, p. 13)

Definitions of Terms

The following terms, as used in this study, are defined as follows.

Cognitive-connectedness schema. Today's students employ a cognitive-connectedness schema when scanning new input. Due to the nature of the Internet, they have learned to "search for, rather than simply look at, information" (Tapscott, 1998, p. 26). As a result, they have developed three cognitive-connectedness structures: navigation literacy, a preference for interactive/discovery-based learning, and an ability to make reasoned judgments based on a plethora of resources (Brown, 1999). This cognitive-connectedness schema could also be defined as students' ability and need to see knowledge not as separate bits of information, but as having "constituent parts [that] index the world and so are inextricably a product of the activity and situations in which they are produced" (Brown, Collins & Duguid, 1989, ¶11).

Distributed cognition. Distributed cognition is the product of intellectual partnerships across or between individuals and/or culturally provided tools (Salomon, 1997).

Expertise structures. Structures that characterize expertise include knowledge, function, and representation (Kim & Hays, 2005; Schumacher & Czerwinski, 1992). These three structures interact with each other during task performances. Knowledge structures include the use of deductive and inductive reasoning, as well as the ability to form internal representations of knowledge (Patel & Groen, 1991). Cognitive function structures include problem-solving strategies, the ability to anticipate results, and to evaluate performance (Glaser & Chi, 1988). Representation structures include the ability to generate external representations of a problem or process, the ability to reflect on these images, and to make use of these reflections when making decisions (Ericsson & Charness, 1994; Glaser & Chi, 1988).

Expert performance. An expert performance is defined as “consistently superior performance on a specified set of representative tasks for the domain that can be administered to any subject” (Ericsson & Charness, 1994, p. 731). An expert performance is characterized by the development a working hypothesis, and reliance upon systematic representations of information related to the problem, in relation to domain-specific knowledge structures (Ericsson, 1996).

Instructional design. The IEEE *Reference Guide for Instructional Design and Development* defined instructional design as “the process through which an educator determines the best teaching methods for specific learners in a specific context, attempting to obtain a specific goal” (IEEE, 2002). Kemp, Morrison, and Ross (1998) listed nine elements instructional designers should consider in their planning: instructional problems, learner characteristics, subject content, instructional objectives, sequence content, instructional strategies, instructional message and delivery, evaluation, and resources.

Instructional design model. An instructional design model helps designers to visualize an instructional problem and then break it down into discrete, manageable units (Ryder, 2006). ADDIE is one of these models, representing the steps of analyzing, designing, developing, implementing, and evaluating (Watson, 1981). The ASSURE model prescribes six events: analyze learners, state objectives, select instructional methods, media, and materials, utilize media and materials, require learner participation, evaluate and revise (Molenda, Russell, Smaldino, & Heinich, 1996). The 4C-ID instructional design model emphasizes the implementation of four components: learning tasks, supportive information, procedural information, and part-task practice (van Merriënboer, Kirschner, & Kester, 2003). The SOI model emphasizes the processes enabling students to (S) select relevant information from a lesson, (O) organize selected information into coherent mental representations, and (I) integrate incoming information with existing knowledge (Mayer, 1999).

Instructional design strategy. Instructional strategies can include “expositive strategies in which receptive learning is central” as well as “discovery strategies in which experiential learning is central” (Terlouw, 1997, p. 350). According to Merrill (1999), “Instructional strategies include the presentation of the appropriate knowledge components, practice with or student activities involving these knowledge components, and learner guidance to facilitate the student’s appropriate interaction with these knowledge components” (p. 400).

Intermediate performance. An intermediate performance is characterized by the use of diagnostic reasoning, data-driven reasoning, observation, and problem reduction, rather than a dependence upon underlying principles (Glaser, & Chi, 1988).

Knowledge. Knowledge is the result of interactions between the schemata in long-term memory and new content from the environment (Clark, 2003). As referenced in Bloom's Taxonomy (Jonassen, Tessmer, & Hannum, 1999), knowledge is viewed as the remembering and recalling of information that ranges from the concrete to the abstract (Reigeluth & Moore, 1999). It has two dimensions, the explicit and tacit. According to Brown (2000), the explicit dimension deals with concepts, while the tacit deals with know-how, and is manifested in work practices and skills. Pea (1997) held that knowledge "is commonly socially constructed, through collaborative efforts toward shared objectives or by dialogues and challenges brought about by differences in persons' perspectives" (p. 48).

Levels of expertise. Levels of expertise include novice, intermediate, and advanced.

Novice performance. Novice performance is characterized by reliance upon concrete information, commonsense knowledge, and trial-and-error approaches (Anzai, 1991; Glaser & Chi, 1988).

Schemata. Schemata are procedures used to scan new input to see if it has information relating in some way to previously understood concepts. Schemata provide structures "for understanding a problem situation in general terms, as well as guiding problem-solving performance" (Anderson, Greeno, Kline, & Neves, 1981, p. 206).

Situated cognition. Situated cognition is "the placement of individual cognition within the larger physical and social context of interactions and culturally constructed tools and meanings" (Wilson & Myers, 2000, p. 66). Situated cognition is a prescriptive learning theory. It offers guidelines as to what method or methods to use (such as communities of practice), in order to attain the goal of helping learners develop an identity as a member of a community as they become knowledgeably skillful through their participation in that community.

Social-connectedness schema. Today's students employ a social-connectedness schema when scanning new information. Structures of this schema include students' preferences to link, lurk and lunge (Brown, 2000). Today's students link up with others who have interests similar to their own. They lurk, watching others who know how do to what they want to do. They also lunge, eagerly jumping in to try new things (vs. reading a manual). Learning environments that provide students with opportunities to link, lurk, and lunge will include constructs of their social-connectedness schema. This social-connectedness schema could also be defined as students' ability and need to create and sustain physical, virtual and hybrid social networks (Oblinger & Oblinger, 2005).

Transfer. Transfer is "the ability to extend what has been learned in one context to new contexts" (Bransford, Brown, & Cocking, 2000, p. 51). The requirements for transfer tasks include content/conceptual knowledge, procedural/strategic knowledge, and appropriate dispositions (Lupart, Marini, & McKeough, 1995). These elements are most often found in higher levels of expertise (Clark, 2003). Mayer (1999) proposed three prerequisites for problem-solving transfer: cognitive processes of selecting relevant information from a lesson, organizing selected information into coherent mental representation, and integrating incoming information with existing knowledge.

Assumptions

Based on a review of the literature, this study assumed that students' immersion in a media-rich environment has influenced both their social practices as well as their cognitive processes, leading to the formation of social and cognitive-connectedness schemata (SCCS).

Limitations

The mixed methodology research conducted in this study was limited to the demography of predominantly middle-class suburban 6th grade students. Since data gathering was limited to the accessible population of middle-class suburban 6th grade students, the study's findings can be generalized only in a limited way to a population that manifests similar characteristics.

Since researchers had to obtain caretakers' informed consent when studying minors, the participants in this study must be considered volunteer participants (Gall, Gall, & Borg, 2003). The volunteer status of this study's participants was another limitation because researchers have generalized several differences between volunteer participants and non-volunteer participants. For example, volunteers tend to be higher in need for social approval than non-volunteers. They tend to be more sociable than non-volunteers. They also tend to be less authoritarian than non-volunteers (Gall, et. al). Researchers have also noted several specific differences between children having parental permission to participate in a research study and those who do not. Those having parental permission tend to be more academically competent, more popular with their peers, more physically attractive, more likely to be White, more likely to come from two-parent households, involved in extracurricular activities, less likely to be socially withdrawn, and less likely to be aggressive (Gall, et. al).

In order to minimize sampling bias, the parental consent letter was designed to produce as many individuals as possible in the accessible population. These included making the appeal for volunteers as interesting as possible, making it as non-threatening as possible, explaining the theoretical and practical importance of the study, and making the appeal by someone known to the target sample.

The researcher conducting the study and one other teacher served as the sample's Language Arts teachers during the 2006-2007 school year. Potential researcher bias, therefore, must also be mentioned as a potential limitation. The second Language Arts teacher also helped to oversee the data collection and assessment in an effort to help mitigate this potential bias.

Nature of the Study

This mixed methodology study examined how and to what extent an online instructional strategy that incorporates constructs of students' social and cognitive-connectedness schemata can facilitate transfer when compared with an instructional strategy that does not intentionally incorporate these structures. The participants included 11- and 12-year-olds in a middle-class suburban public school setting. The study's members included three classes of Language Arts students of approximately 29 students each. The classes read an abridged version of Virgil's *Aeneid*. Although situated in a face-to-face environment, students also accessed many materials online.

The classes conducted discussions on the literary elements found in the *Aeneid*, as well as completed worksheets, maps, and short summaries as they read the text. Both groups also completed a final test consisting of fill-ins and matching questions based on the studied material, as well as a final writing assessment. The final writing assessment was designed to assess students' ability to transfer learned concepts to other areas of study. The classes were randomly chosen to receive either traditional instruction, or instruction targeting their social and cognitive-connectedness schemata.

Data collected from students' videotapes, illustrations and textual representations of their mental models, as well as from tests and essays provided comparisons regarding students' levels of expertise and ability to transfer learning to new situations. Using interpretational analysis and analytic induction, the data was segmented based on the variables specified by the theory of expertise, and constructs of students' social and cognitive-connectedness schemata. There was a constant comparison of the segments within and across categories in order to clarify the meanings of each category. Data collection was ongoing, to a point of theoretical saturation.

CHAPTER 2. LITERATURE REVIEW

Introduction

Research shows that students' immersion in today's digital culture has effected changes in their learning schemata. Today's instructional designers must prescribe more than just cognitive, constructivist, situativist, or situated cognition learning environments if they hope to facilitate transfer. Some designers who hold constructivist and situativist views would not agree. Bednar, Cunningham, Duffy & Perry (1992) wrote that it is "inconceivable to mix epistemologies in an instructional program" (p. 19) and urged instructional designers to choose a purely constructivist perspective. Others, such as Barab & Duffy (2000), have argued for situativist instructional designs that primarily focus on the interactions among students where "meaning as well as identities" are constructed (p. 47). Other researchers and educators however, such as Ally (2004) and van Merriënboer, Kirschner, and Kester (2003), have argued that designs based on a combination of theories will best meet the needs of today's learners. This chapter reviews the literature concerning these various learning theories, concluding that instructional strategies that include constructs of students' social and cognitive-connectedness schemata (SCCS) can better facilitate transfer.

Cognitivism

Reigeluth and Moore (1999) have defined cognitive education as being composed of “the set of instructional methods that assist students in learning knowledge to be recalled or recognized, as well as developing students’ understandings and intellectual abilities and skills” (p. 52). The field of cognitive science emerged in the late 1950’s, and approached learning from perspectives that included anthropology, linguistics, philosophy, several branches of psychology, and computer science (Bransford, Brown & Cocking, 2000). Cognitivists began to emphasize learning with understanding, rather than just focusing on learning as a process of connections between stimuli and response, as did the earlier behaviorists. As society changed, learning theories changed with it. Reigeluth (1999) pointed out, “when a human-activity system (or societal system) changes in significant ways, its subsystems must change in equally significant ways to survive” (p. 16). In the agrarian age, businesses were organized around the family. In the industrial age, businesses were organized around established bureaucracy and departments. Now, in the information age, businesses emphasize teamwork. Educational paradigms have paralleled these shifts. The standardized instructions of behaviorists focused on sorting and efficiency, as did the assembly-line model of the industrial age. In the information age, education has begun to focus on equipping workers to think and solve problems, to work in teams, and to communicate and take initiative.

Instructional designs based on cognitive learning theory focus on the most effective ways to facilitate the acquisition of knowledge, and on the creation of problem-solving environments (Dijkstra & van Merriënboer, 1997; Barab & Duffy, 2000). Lessons are designed so that students can organize information into a conceptual framework, leading to greater opportunities for transfer (Bransford, Brown & Cocking, 2000). As Reigeluth and Moore (1999) pointed out, this “concern for internal knowledge structures was one of the major benefits of cognitive learning theory over behaviorist learning theory” (p. 54). Instructional designs based on a cognitive theory of learning will help structure the learning environment so that students can move from achieving lower level objectives, such as knowledge and comprehension, to achieving higher levels of application, analysis, synthesis and evaluation.

Constructivism

The use of cognitive strategies has its place in an online learning environment, however, students experiencing instructional designs based solely on the cognitive theory of learning will be not fully prepared for life in the 21st century. According to the U.S. Department of Education (2006), “America’s share of the world’s science and engineering doctorates is predicted to fall to 15 percent by 2010” (p. 4). Students from other countries outperform ours in international tests (U.S. Department of Education). Friedman (2006) explained that the information age is slowly giving way to what he calls the talent age and that, in our flattened world, the only way companies and countries can maintain a sustainable edge is through “the distinctive talents and entrepreneurship of their workforce” (p. 328). One way to maintain this edge, Friedman advised, is for countries to put into place “the right education programs and knowledge skills to empower more of their people to innovate and do value-added work on that platform" (p. 329). Constructivists believe that instructional designs based on constructivism will help us maintain this edge.

Constructivists hold that learning is a process in which the learner builds an "internal representation of knowledge, a personal interpretation of experience" (Bednar, Cunningham, Duffy, & Perry, 1992, p. 21). Knowledge is constructed from previous knowledge, and learners construct knowledge as they attempt to make sense of their experiences (Boulton, 2002; Bransford, Brown, Cocking, 2000). Unlike cognitivists, constructivists do not view knowledge content as having identifiable components that can be classified "based on the nature and the content and the goals of the learner" (Bednar, et al., p. 23). Instead, constructivists hold that content cannot be prespecified because learners must construct their own particular understandings or viewpoints. Instructional designs based on the learning theory of constructivism structure learning experiences so that they can be easily understood and modified by learners, thus creating learning environments that facilitate exploration, extrapolation, and elaboration (Campbell, 1998).

While some learning theorists, such as Bednar, Cunningham, Duffy and Perry (1992), hold that cognitivism and constructivism are incompatible because they are based on different epistemologies of what it means to know, others believe they are compatible. Jonassen (1999) proposed that using elements from both cognitivism and constructivism can provide "different perspectives on the learning process from which we can make inferences about how we ought to engender learning. I prefer to think of them as complementary design tools to be applied in different contexts" (p. 217). For Jonassen, constructivist elements in an online design include fostering communities of learners, and engaging learners in solving authentic problems. As discussed later in this section, the 4C/ID model is one example of an instructional strategy that effectively combines both cognitive and constructivist elements in its design.

Situativity

Proponents of the situativity learning theory see knowledge as reciprocal with doing. Rather than viewing knowledge as a self-contained entity, as in cognitivism, or merely as the learners' construction their own particular understandings or viewpoints, knowledge is viewed as a tool that can only be fully understood through use. This kind of knowledge is something that can only truly be constructed, along with identities, within a "community of practice" (Barab & Duffy, 2000). Situated learning "refers to the idea that cognitive processes are situated (located) in physical and social contexts" (Ghefaili, 2003, p. 5.) Situativity takes its cues from the ideas of Vygotsky (1930) in that human development and learning flow out of social and cultural interaction. Vygotsky wrote that individuals "only exist as social beings, as members of some social group" (¶4). He believed that an individual's "personality and the structure of his behaviour turn out to be a quantity which is dependent on social evolution and whose main aspects are determined by the latter" (¶4). In situativity, knowledge is situated in culture, and within an historical context. Meaning is the result of participation in social activities (Ghefaili, 2003). In this theory of learning, there is a "shift in the unit of analysis from the individual's context to the community context" (Barab & Duffy, p. 26). Other situativists have further defined this unit of analysis as “neither the individual nor the setting, but instead the relationship between the two, as indicated by the student’s level of participation in the setting” (Dede, Nelson, Ketelhut, Clarke, & Bowman, 2003, p. 4). Proponents of situativity believe instructional designs based on this learning theory will better equip learners for life in the talent age.

The theory of situativity has its limitations. One of the difficulties with situativity is that it has a hard time explaining the transfer of knowledge from one setting to another. If knowledge is not a stand-alone entity, but rather a social construction expressed in the actions of people interacting within communities, then the metaphor of "transfer" breaks down because there is "nothing to be carried over" (Wilson & Meyers, 2000, p.72). As Barab, Hay, and Yamagata-Lynch (2001) pointed out, “The difficulty in finding methods for capturing this unit of analysis lies in the fact that it is distributed spatially and temporally across multiple components” (p. 65).

The possibility of "fossilization" is another potential problem when developing designs based solely on the theory of situativity. According to Wilson and Meyers (2000), fossilization occurs when learners do not progress to a higher level of mastery because mistakes have become part of the learner's permanent repertoire. For example, an English speaker for whom Mandarin is her first language may have difficulty pronouncing sounds such as "th", "k", “fr”. Once the speaker reaches a basic fluency, however, classmates or co-workers might accept inaccurate pronunciations (such as “flied” instead of “fried”) because both parties have reached a reasonable level of understanding. In the same way, learning based solely on communities of practice may result in some things being learned incorrectly, causing students to fossilize at incorrect, albeit functional levels. Clearly, there is still a place for direct instruction and for information-processing principles to be utilized within effective instructional designs in both traditional as well as in distance learning environments.

One final concern with designing instruction based solely on the theory of situativity is the difficulty of designing and controlling authentic learning environments. Wilson & Meyers (2000) pointed out that authentic communities of practice "are not so much designed, but rather emerge within existing environments and constraints" (p. 77).

Situated Cognition

According to Kirshner and Whitson (1997), the learning theories of constructivism and situativity still do not adequately deal with the problem of transfer. Using anthropological and sociocultural approaches, these theories and designs, with their analyses of persons and resources within communities of practice, still do not adequately address “the problem of transfer from context to context” (Kirshner & Whitson, p. 8). Situated cognition takes a further step. It deals with the problem of transfer by seeking to understand “how apparently discrete contexts are complexly interlinked, and how particular individuals, through multiple positionings in multiple communities, do or do not participate in those linkages.” (Kirshner & Whitson, p. 9). As its name implies, situated cognition seems to fall somewhere between cognition and situativity. The focus is on more than just individual cognition, as in cognitivism. It also focuses on more than just complex social phenomena, as in situativity (Barab, Hay, & Yamagata-Lynch, 2001). The learning theory of social cognition addresses “the structures and interrelations within activity systems” (Kirshner & Whitson, p. 5). It seeks to link the community of practice to broader categories of social and political analysis, rather than just focusing on the community as the unit of analysis. Kirshner and Whitson, however, pointed out that situated cognition “loses part of its potential to inspire education” (p. viii) because it redirects attention to the social and cultural aspects of knowledge and learning, while neglecting the intrapersonal dimensions. They issued a call for learning theorists to develop a “cohesive and coherent theoretical approach” to their learning theory that takes into account “all aspects of our human cognitive engagement with our worlds” (Kirshner & Whitson, p. 1).

Students a Moving Target

Instructional designers need a more unified theory of learning that accounts for changes in students’ schemata due to the affordances of technology. As Schaller and Allison-Bunnell (2003) suggested, we are in a “pre-paradigmatic phase of learning style research. The blind researchers have each described a different part of the elephant, but have not yet synthesized their findings into a picture of the whole beast” (p. 3). The problem in providing a “picture of the whole beast” lies in the fact that our tools for learning continue to change at an amazing pace, and the way we learn changes with it.

Valdez, et al. (2000) pointed out that we are in danger of our hardware and software developments overwhelming any input that we might get from educational research. Learning theories are grounded in research. Instructional designers base their designs upon research that has been validated by the use of particular learning theories to meet certain objectives, in specific instructional settings. If the way students learn changes as their learning tools change, and if research can't keep up with the changes in these tools and the resulting changes in how we learn, then a unified theory of learning will prove even more elusive. Gibson (2003) explained that the computer, as an extension of thinking, transforms the reach and power of the mind. "Technology mediates knowledge and thus fundamentally changes our conception" of learning (Gibson, ¶1). An argument can be made that, just as land provided an environment for creatures to evolve, so too the computer and global networks have provided new media for learning, opening up new possibilities for the evolution of learning theories. We need new instructional designs and strategies that match the unique capabilities and features available in an online environment.

Social and Cognitive-Connectedness Learning Theory

This study sought to describe more of the "elephant" by developing instructional strategies based on students' social and cognitive-connectedness learning schemata (SCCS). It examined how and to what extent instructional strategies that targeted constructs of students' social and cognitive-connectedness schemata facilitated learning transfer when compared with instructional strategies that did not target these constructs.

First, the learning theory of students' social and cognitive-connectedness proposes that today's students employ a social-connectedness schema when scanning new information. Structures of this schema include students' preferences to link, lurk and lunge (Brown, 2000). Today's students link up with others who have interests similar to their own. They lurk, watching others who know how do to what they want to do. They also lunge, eagerly jumping in to try new things (vs. reading a manual). Learning environments that provide students with opportunities to link, lurk, and lunge will include constructs of this social-connectedness schema. This social-connectedness schema could also be defined as students' ability and need to create and sustain physical, virtual and hybrid social networks (Oblinger & Oblinger, 2005).

Second, the SCCS learning theory proposes that today's students also employ a cognitive-connectedness schema when scanning new input. Due to the nature of the Internet, they have learned to "search for, rather than simply look at, information" (Tapscott, 1998, p. 26). As a result, they have developed three cognitive-connectedness structures: navigation literacy, discovery-based learning, and an ability to make reasoned judgments based on a plethora of resources (Brown, 1999). This cognitive-connectedness schema can also be defined as students' ability and need to see knowledge not as separate bits of information, but as having "constituent parts [that] index the world and so are inextricably a product of the activity and situations in which they are produced" (Brown, Collins & Duguid, 1989, ¶11).

Instructional designs based on a theory of students' social and cognitive-connectedness schemata will focus on more than just the acquisition of knowledge, the construction of knowledge through experience, or the formation of identity within a community of practice. As Lupart, Marini and McKeough pointed out, theorists have emphasized, “at one time or another the importance of each basic element of transfer – task, learner, and context” (1995, p. 4). They have advised, however, that theorists take all three into account when designing instruction. The theory of students’ social and cognitive-connectedness schemata focuses on all three elements. As in situated cognition, designs based on students’ social and cognitive-connectedness schemata deal with the problem of transfer by seeking to understand cognition within the context of the community of practice. Cognition is viewed as problem-solving ability, and takes into account the personal, local, and cultural forces that contribute to this ability. However, unlike constructivism, situativity and situated cognition, this learning theory views knowledge as the result of interactions between students’ schemata in long-term memory and new content from the environment (Clark, 2003). As referenced in Bloom’s Taxonomy (Jonassen, D., Tessmer, M., Hannum, W. (1999), it takes the view of knowledge as the remembering and recalling information that ranges from the concrete to the abstract (Reigeluth & Moore, 1999). It is also recognizes knowledge as having two dimensions; the explicit and tacit. According to Brown (2000), the explicit dimension deals with concepts, while the tacit deals with ‘know-how,’ and is manifested in work practices and skills. Pea (1997) held that knowledge “is commonly socially constructed, through collaborative efforts toward shared objectives or by dialogues and challenges brought about by differences in persons’ perspectives” (p. 48).

The theory of students’ social and cognitive-connectedness schemata recognizes that knowledge can be both socially as well as individually constructed.

“The cognitive growth of an individual cannot be understood without understanding the development of joint relationships, because a person’s growth is indeed the result of the distributed work with the environment” (Kim & Hays, 2005). It stops short, however, of declaring, as Lave (1988) did, that knowledge and cognition are “stretched over, not divided among—mind, body, activity and culturally organized settings” (p. 1). In dealing with the problem of transfer, the theory of students’ social and cognitive-connectedness schemata views knowledge and cognition as both personally and socially constructed. In this context, this study examined how and to what extent online instructional strategies that targeted constructs of students’ social and cognitive-connectedness schemata facilitated transfer when compared with strategies that did not target these constructs.

Levels of Expertise, Structures of Expertise, and Transfer

In order to measure transfer, this study used interpretational analysis and analytic induction to relate the constructs of students’ social and cognitive-connectedness schemata with levels of expertise. The constructs of students’ social-connectedness schema include their preferences to link, lurk and lunge (Brown, 2000). Constructs of students’ cognitive-connectedness schema include navigation literacy, discovery-based learning, and an ability to make reasoned judgments based on a plethora of resources (Brown, 1999). The research correlated evidences of these constructs with expert performance levels of novice, intermediate, and advanced. These three levels of expertise were delineated using the expertise structures of knowledge structures, cognitive functions, and mental representations. This provided a basis for examining how and to what extent the instructional strategies based on students' cognitive and social-connectedness schemata facilitated transfer when compared with the instructional strategies that did not target these constructs.

Levels of Expertise

An expert or advanced level of performance is defined as a "consistently superior performance on a specified set of representative tasks for the domain that can be administered to any subject" (Ericsson, & Charness, 1994, p. 731). An expert performance is characterized by the development a working hypothesis, and reliance upon systematic representations of information related to the problem, in relation to domain-specific knowledge structures (Ericsson, 1996). An intermediate performance is characterized by the use of diagnostic reasoning, data-driven reasoning, observation and problem reduction rather than a dependence upon underlying principles (Chi, Glaser, & Chi, 1988). A novice performance level is characterized by reliance upon concrete information, commonsense knowledge, and trial-and-error approaches (Anzai, 1991; Glaser & Chi, 1988; Kim & Hay, 2005; Patel & Groen, 1991).

Structures of Expertise

In order to measure transfer, this study isolated the three structures that characterize expertise. These include knowledge, function, and representation (Kim & Hays, 2005; Schumacher & Czerwinski, 1992). These three structures interact with each other during task performances. Knowledge structures include the use of deductive and inductive reasoning, as well as the ability to form internal representations of knowledge (Patel & Groen, 1991). Cognitive function structures include problem-solving strategies, the ability to anticipate results, and to evaluate performance (Glaser, & Chi 1988). Representation structures include the ability to generate external representations of a problem or process, the ability to reflect on these images, and to make use of these reflections when making decisions (Glaser, & Chi, 1988; Ericsson & Charness, 1994).

Transfer Measurement

The instructional strategies used in this research were based on the learning theory of student's social and cognitive-connectedness schemata. This study examined how and to what extent the use of these instructional strategies facilitated transfer, as measured by the levels of expertise and expertise structures. This data was compared with test results from classes that received traditional instruction.

Instructional Strategies

The SCCS instructional strategies used in this study combined elements from Mayer's SOI model of learning (1999) with strategies suggested by the 4C/ID model of van Merriënboer, Kirschner, and Kester (2003). In addition, the SCCS strategies used in the study also incorporated the three stages of Wiggins and McTighe's understanding by design model (1998), and elements of game design.

SOI Model

Mayer's SOI model (1999) emphasizes the facilitation of students' ability to: (S) select relevant information from a lesson, (O) organize selected information into coherent mental representation, and (I) integrate incoming information with existing knowledge. After learners select relevant information to be retained in working memory, students then connect this information with "pictorial and verbal cause-and-effect chains" (Mayer, p. 148). Learners then organize the selected visual images and sounds into visual and verbal mental models. Finally, students integrate these mental models into their long-term memory as they make mental connections between their visual and verbal mental models and their prior knowledge.

4C/ID Model

The 4C/ID model seeks to fill a gap between education's current emphasis on authentic learning tasks, and learners' overwhelming sense of task complexity within these authentic learning environments (van Merriënboer, Kirschner, & Kester, 2003). The four-component instructional design model "presupposes that well-designed learning environments for complex learning always consist of four components" (van Merriënboer et al., p. 11). These components are learning tasks, supportive information, procedural information, and part-task practice. The 4C/ID model carefully weaves guidelines offered by the cognitive load theory into its design in order to decrease "intrinsic and extraneous cognitive load, so that sufficient processing capacity is left for genuine learning" (van Merriënboer et al., p. 5). These four components initially provide learning tasks that offer worked-out examples that "confront learners not only with a given state and a desired goal state but also with an example solution" (van Merriënboer et al., p. 7). The model suggests that instructors provide just-in-time learning, provide simple-to-complex sequencing, and scaffold whole-task practice. Learning under these conditions will lessen students' cognitive load, effecting greater levels of transfer.

Understanding by Design Model

Wiggins and McTighe's (1998) understanding by design model (W&M) encourages instructors to articulate enduring understandings at the beginning of their unit planning. Enduring understandings focus on concepts, principles, or processes, rather than discrete facts or skills. For example, students involved in this research study read an abridged version of the *Aeneid*. One of the unit's enduring understandings was the idea that culture is history in the present. Wiggins and McTighe's understanding by design model outlines three planning stages. In stage 1, instructors identify the desired outcomes and results. In stage 2, they determine acceptable evidence of competency in the desired results. During stage 3, instructors plan strategies and learning experiences to move students toward these competency levels. In the understanding by design model, instructors are encouraged to help students "uncover" the enduring understandings, much akin to discovery-based learning.

Elements of Game Design

The instructional strategies used in this research also included elements of game design. Gaming environments have been found to increase student motivation (Aldrich, 2004; Jenkins, 2005; Prensky, 2001; Youngblut, 1998). Rieber proposed that the "construct of play is our best candidate for wedding cognition and motivation within learning environments" (Rieber, 2001, p. 2). Motivation is also a crucial component of transfer (Lupart, Marini, and McKeough, 1995). Motivation is responsible for "close to 50% of the variance in achievement" (Clark, 2003, p. 196).

Learning environments that include elements of game design engender this kind of motivation.

Game designer Greg Costikyan (1994) listed five crucial gaming elements: decision-making opportunities, goals, opposition, resource management, and information. Aldrich (2004) listed four essential gaming ingredients, specifically related to simulation gaming experiences: authentic and relevant scenarios, applied pressure situations that tap users' emotions and force them to act, replayability, and a sense of unrestricted options. Guidelines for developing instructional strategies that incorporate elements of game design can be extrapolated from a comparison of these lists.

First, Aldrich's gaming element of authentic and relevant scenarios elaborates on Costikyan's criteria of providing goals. Authentic and relevant scenarios enable players to buy into the gaming environment, giving players a vested interest in the game's goals. Second, instructional strategies that stir players' emotions will inject a level of pressure into gaming situations by forcing players to make decisions about resource management so that players can defeat their opposition and reach their goals. Third, replayability allows users to retrace their steps in order to make decisions more in line with their goals. For example, players might choose to replay an instance of the game because completed plays might uncover an unforeseen opposition or reveal an opportunity for better resource management. Unwanted plays might also reveal previously unknown or overlooked information. Fourth, a sense of unrestricted options makes the gaming environment appear more authentic. When provided with a sense of unrestricted options, players are less likely to feel as though their decisions were made within the confines of a gaming environment, thus contributing to a sense of presence as well as a sense of fantasy (Malone & Lepper, 1987; Towell & Towell, 1997). A sense of presence is important in a gaming environment because it helps players to maintain “the willing suspense of disbelief, the feeling that the game world is alive and colorful and consistent” (Costikyan, 1994, Roleplaying, ¶6).

The instructional strategies used in this study incorporated many of these gaming and simulation elements. For example, one instructional strategy included the use of an online virtual world called the *Aeneid* Rome KaMOO (see Appendix A). In this virtual world, students role-played characters from the *Aeneid*. Using resources in the gaming environment, students made decisions similar to ones faced by their characters as they confronted opposition and pursued game goals. The better that students understood the story of the *Aeneid*, the better they fared in the virtual world.

Figure 1 illustrates how SCCS instructional strategies can incorporate constructs of students’ social and cognitive-connectedness schemata, the three instructional design models, and elements of game design.

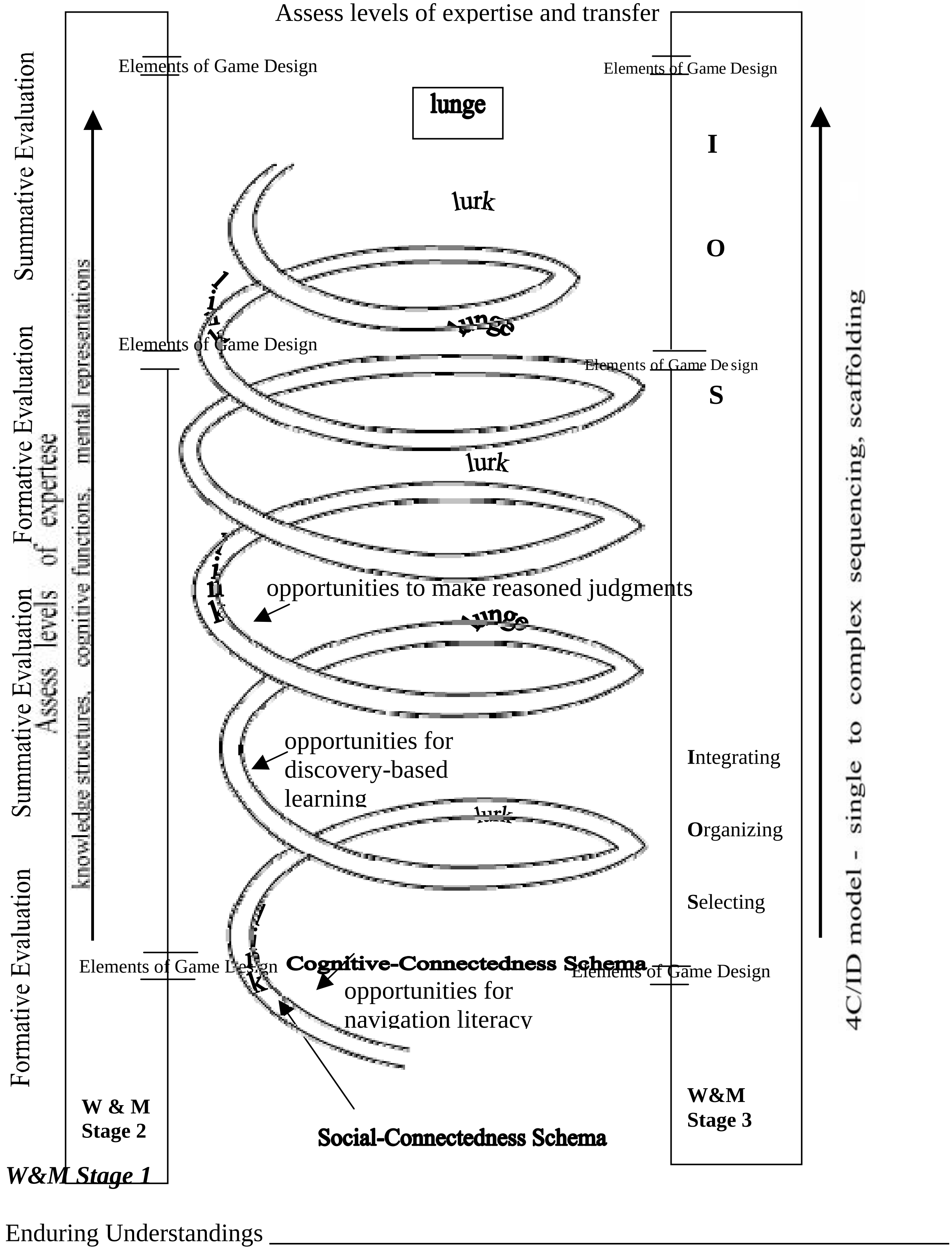


Figure 1. Instructional strategies integrated with students' SCCS, SOI, 4C/ID, W&M models, and elements of game design.

Educators who base their instructional strategies on *Figure 1* will first articulate the unit's enduring understandings (W&M Stage 1). Second, instructors will design formative and summative evaluations that assess students' level of expertise as the students engage in the unit of study. These evaluations will enable teachers to distinguish between students' use of knowledge structures, cognitive functions, and mental representations (W&M Stage 2). Some of the formative and summative evaluations, however, may not be fully developed until instructors determine the appropriate audio and visual (including text) resources they will make available to students throughout the unit. Third, using the 4C/ID model of single-to-complex-sequencing and scaffolding, instructors will choose the various text, audio, technology, and distributed cognition tools they will make available to students. Using these tools, students will then be able to select, organize and integrate the new information into their existing schemata (Mayer, 1999). As students select, organize and integrate information, instructors will create opportunities for students to develop their navigation literacy, preference for discovery-based learning, and abilities to make reasoned judgments based on a plethora of resources (W&M Stage 3). These opportunities are illustrated by the right strand of the upward spiral, and comprise elements of students' cognitive-connectedness schema. At the same time, instructors will also provide opportunities for students to link, lurk, and lunge as learners interact with the unit under study and with each other. Students' social-connectedness schema is illustrated in the upward spiral band. These instructional strategies will provide students with opportunities to select, organize, and integrate information as it interacts with their social and cognitive-connectedness schemata in an upward, yet recursive pattern. This pattern supports the complex sequencing and scaffolding of the 4C/ID model, and will help prevent cognitive overload. Formative evaluations throughout the process will also cue instructors as to the efficacy of the chosen scaffolding methods, and the level of students' cognitive load.

The occasional breaks in the left and right-sided rectangles represent the infusion of game design elements into the instruction in order to motivate students, and to engage students' use of their social and cognitive-connectedness schemata. In the course of this research study, these instructional strategies included students' role-play of characters from the *Aeneid* using the online *Aeneid* Rome KaMOO (http://kamoo. dragonangel.net: see Appendix A). The better students understood the story of the *Aeneid*, the more they experienced success in the online virtual game played at the end of the unit. Other game-infused instructional strategies used in this study included playing an online vocabulary cloze game (http://www.quia.com/cz/ 12774.html: see Appendix B), and an online Gods and Goddesses *Jeopardy!* Game (http://kamoo.dragonangel.net/~marie/kamoowbpg/GodsGoddessJepdy.ppt: see Appendix C). Lesson Plans for the *Aeneid* unit using these instructional strategies are outlined in Appendix D. Traditional Lesson Plans for the *Aeneid* unit are outlined in Appendix E.

Summary

Prensky (2006) stated, "research by social psychologists shows that people who grow up in different cultures don't just think about different things, they actually *think differently*" (p. 34). Although the Net Generation's culture overlaps with those of the two previous generations, K-12 students perceive and utilize information and communication technologies differently than do their parents and grandparents. This has resulted in the development of new social and cognitive-connectedness schemata. Instructional designers need to incorporate constructs of students’ new schemata into their instructional designs and strategies. This study examined how and to what extent instructional design strategies that facilitated students’ social and cognitive-connectedness schemata affected learning transfer in K-12 education.

CHAPTER 3. METHODOLOGY

Research Purpose

The purpose of this study was to examine how and to what extent online instructional design strategies that facilitated students' social and cognitive-connectedness schemata would affect learning transfer in K-12 education.

Hypothesis

Instructional design strategies that facilitate schema acquisition will increase levels of learning transfer.

Research Design

This mixed methodology study conducted *t* tests on the students' California Standardized Test scores taken at the end of 5^{th} grade, and then conducted *t* tests on the their 6^{th} grade *Aeneid* test scores to determine any significant differences between the groups. During the *Aeneid* unit, two of the classes received instruction that utilized SCCS instructional strategies, and one class received traditional (non-SCCS) instruction. Data gathered from these *t* tests provided a measurement of how and to what extent the SCCS instructional strategies affected student learning.

Interpretational analysis was used to identify students' use of expertise structures. Data generated from this analysis was tagged with category codes in order to relate them with students' use of their SCCS. All data was analyzed using the method of analytic induction. Katz (2001) explained that this methodology supports what he termed retrodiction, which he defined as “assertions that if a given behavior is observed to have occurred at time 2, specific phenomena will have occurred at time 1” (p. 12).

The expertise structures specified by the theory of expertise include the use of knowledge structures, cognitive functions, and mental representations. Data evidencing students’ use of these structures was categorized according to novice, intermediate, and advanced levels of expertise (Kim & Hays, 2005; Schumacher & Czerwinski, 1992). Appendix F illustrates relations between these structures and levels of expertise. Instances of students’ use of these structures was coded, segmented and categorized to create a database illustrating participants’ levels of expertise, as shown in Appendix G. These instances were elicited from students’ video transcripts, illustrations, and textual descriptions of their mental models. These instances were also be analyzed to identify students’ use of their social and cognitive-connectedness schemata (Appendix H). These segments were then grouped together and tagged with category codes in order to relate instances evidencing expertise levels with students’ use of their SCCS. Quantitative data was also drawn from students’ tests and essays in order to compare transfer level differences between the groups.

Participants included eleven to twelve-year-olds in a middle-class suburban public school setting. The study included three classes of Language Arts students, with 23-29 participants in each class. All three classes read an abridged version of Virgil’s *Aeneid*. Although situated in a face-to-face environment, students accessed online materials. All classes conducted discussions on the literary elements found in the *Aeneid*, and completed worksheets, maps, short summaries, and small group projects as they read the *Aeneid*. The classes also completed tests consisting of fill-ins and multiple-choice items based on the studied material, as well as writing assessments.

The classes were randomly selected to receive lessons that incorporated SCCS instructional strategies, as illustrated in *Figure 1*, or traditional (non-SCCS) instructional strategies, as shown in *Figure 2*. For example, students receiving SCCS instructional strategies participated in blogs and online interactive games and quizzes as represented in Appendix B and Appendix C. All students participated in the online virtual world, Rome KaMOO, however, students receiving SCCS instructional strategies participated in the online world before completing their final essay. Those receiving traditional instruction participated in the online world game after writing their final essays. Lesson plans that were based on the instructional strategies illustrated in *Figure 1* are included in Appendix D. Lesson plans based on *Figure 2* instructional strategies are included in Appendix E.

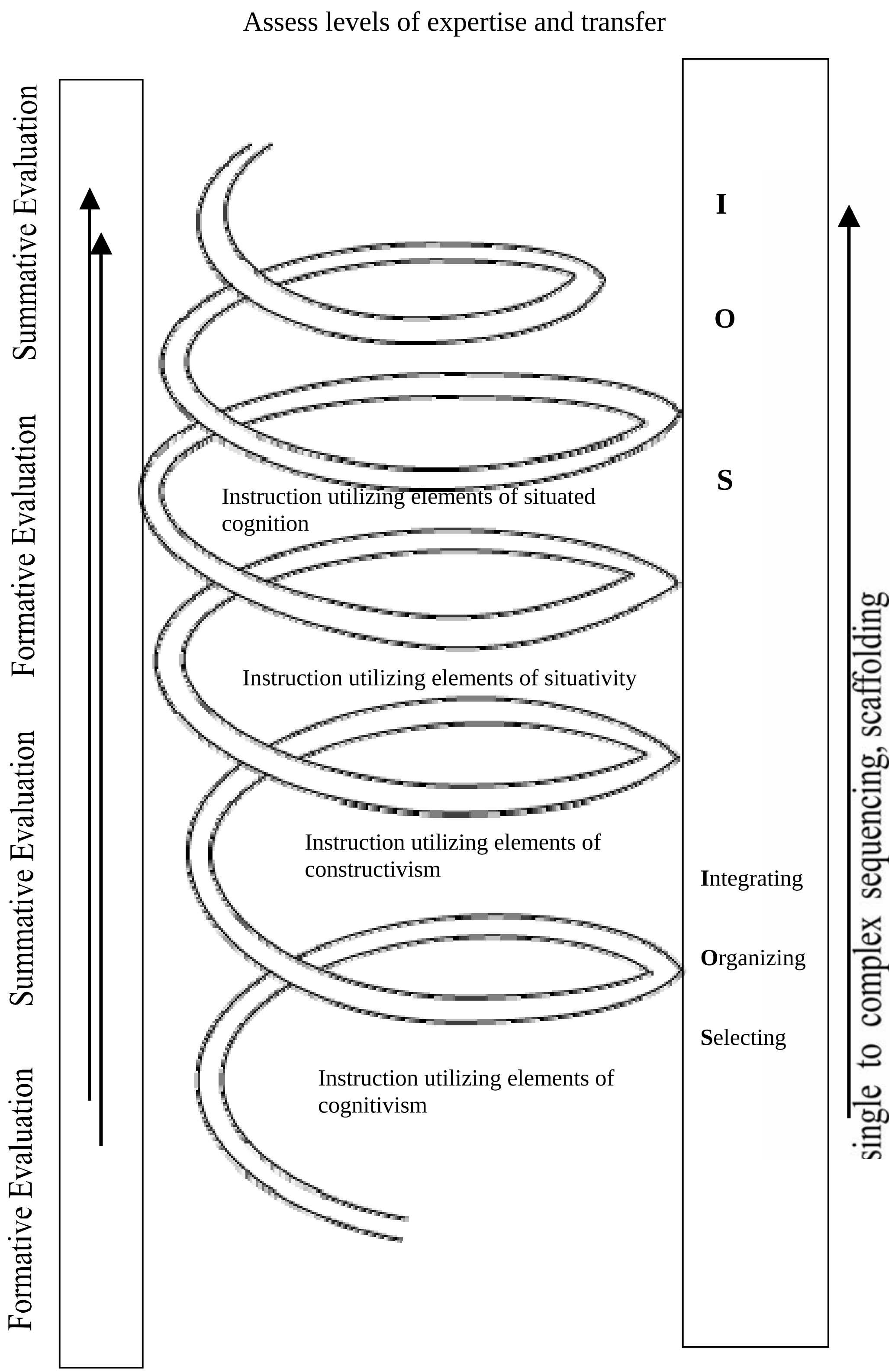


Figure 2: Traditional instructional strategies.

The traditional instructional strategies (*Figure 2*) differed from the SCCS strategies in that they did not include constructs of students' social and cognitive-connectedness schemata. The second group did not have targeted opportunities to link, lurk and lunge. For example, the traditional lessons did not make use of the whole-class *Jeopardy!* review games, or the online matching, flashcard, concentration, battleship, hangman, cloze, or word search games during class time. Instead, students receiving traditional instruction created their own flash cards and had personal time to study in class. The online review games were not made available to students receiving traditional instruction, but these students were able to access the online games on their own in the school library either before or after school, during breaks or lunch, or at home. Students receiving traditional instruction knew about and participated in the online virtual world of Rome KaMOO, but did not have an opportunity to experience the game until after the completion of their final essay.

In addition, the traditional lessons did not intentionally target constructs of students' cognitive-connectedness schema. For example, during class time, students receiving traditional instruction did not utilize blogs, or have planned opportunities to employ or develop their navigation literacy skills. Traditional lessons did not include opportunities for discovery-based learning. Students worked individually to complete chapter reviews instead of being allowed to work in groups. All classes discussed the four themes that were woven throughout the *Aeneid*, examined how these themes were connected to specific events in the *Aeneid*, and discussed how the themes related to modern-day events. In addition to whole-class discussions, the classes also explored the unit's themes through student-created illustrations and essays written throughout the unit. Only the SCCS instructional strategies, however, utilized Wiggins and McTighe's understanding by design model in the presentation of the themes.

Sources of Data

T tests were conducted to compare the three classes' entry-level Language Arts abilities, as measured by the participants' California Standardized Test scores in Language Arts, taken at the end of their 5^{th} grade year. *T* test scores were also used to determine if there were any significant differences between the three classes' *Aeneid* test scores. The results of these *t* tests provided data to determine how and to what extent the SCCS instructional strategies impacted student learning.

Data was collected from students' verbal, illustrated, and written descriptions of their mental models, as well as from their tests and essays. This data provided information regarding students' levels of expertise and the use of their social and cognitive-connectedness schemata. For example, all data information, such as video transcripts, and students' descriptions of their mental models was typed and formatted into computer files. These files and lines of text were assembled into a context-coded database, and a number was assigned to each illustration or line of text. The context-coded database was then segmented into analysis units of category constructs as specified by the theory of expertise and constructs of students' SCCS (Appendices G and H). These segments were then grouped together and tagged with category codes in order to relate instances evidencing expertise levels with students' use of their SCCS (Appendices J and K).

All data and research notes were under the sole control of the researcher. Students' names, economic status, and ethnicity remained anonymous. Files of identifiable data, will not be made public, and will be deleted or destroyed after the publication of this study. All method used to gather evidence from students received approval from the University Institution Review Board before its implementation. One other teacher not involved in the design of the study provided checks on the reliability of the experimenter's observations of the participants' responses.

Sample and Population

The sample for this mixed methodology study included eleven to twelve-year-olds in a middle-class suburban public school setting. The middle school students in the study include three Language Art classes of 6th grade boys and girls in San Jose, California. Since this study's data gathering was limited to a sample of the experimentally accessible population of these students, the study's findings can only be generalized to a population with similar characteristics. As suggested by Gall, Gall, and Borg (2003), the study provided a thick description of the participants and contexts "so that readers who are interested in applying the findings can determine how similar they are to the situation" (p. 466).

Data Collection Strategies

At specified points during the *Aeneid* unit, participants created videotapes as well as visual and textual descriptions of their mental processing models. For example, student descriptions were elicited from all classes whenever one group received targeted instruction to help them link their cognitive-connectedness schema to the unit's enduring understandings. Transcripts of these descriptions were used to ascertain students' use of expertise structures and levels of expertise, as described in Appendix F. Using interpretational analysis, the data was then segmented and coded to create a category database delineating participants' use of knowledge structures, cognitive functions, and mental representations, as illustrated in Appendix G. These segments were also tagged with category codes that evidenced students' use of their social and cognitive-connectedness schemata. Analytic induction was then used to analyze the data in order to relate instances evidencing expertise levels with students' use of their SCCS.

Scores from the participants' California Standardized Test (CST), taken at the end of 5th grade, were analyzed to appraise any significant differences between the classes' Language Arts entry-level abilities. *T* tests assessing any significant score differences were also conducted after the classes completed their final *Aeneid* tests and essays. These measurements were then analyzed to determine if there were any significant differences between classes that received traditional instruction and classes that received SCCS instruction during the *Aeneid* unit.

Instrumentation – Internal and External Validity

T tests were conducted to compare the three classes' entry-level Language Arts abilities, as measured by the participants' California Standardized Test scores in Language Arts, taken at the end of their 5th grade year. *T* test scores were also used to determine any significant differences between the three classes' *Aeneid* test scores.

The results of these *t* tests provided data to determine how and to what extent the SCCS instructional strategies impacted student learning. The classes met the criteria for valid *t* test scores: the scores formed an interval scale of measurement, the scores in the populations under study were normally distributed, and the score variances were equal (Gall, Gall, & Borg, 2003).

Studies based on the theories and results of previous research provide greater evidence of validity (Gall, Gall, & Borg, 2003). The levels and structures of expertise used in this study were derived from published research as previously outlined in this study. These levels and structures of expertise were correlated with constructs of students' social and cognitive-connectedness schemata. Constructs of these schemata were educed from current research regarding the effects of society's new information technology upon students' social practices and cognitive processes. The measurement of participants' transfer ability (Appendix I) was based in part on Bloom's Taxonomy of Educational Objectives (Jonassen, D., Tessmer, M., Hannum, W. (1999). Data collection procedures included qualitative methods such as videotapes, and students' illustrated and textual descriptions of their mental models. Data collection methods also included quantitative measures in the form of test and essay answers. The use of these various methods provided a greater level of validity through triangulation.

Construct validity "is the extent to which a measure used in a case study correctly operationalizes the concepts being studied" (Gall, Gall, & Borg, 2003, p. 460). Using interpretational analysis, the data was segmented based on the expertise structures specified by the theory of expertise, and constructs of students' social and cognitive-connectedness schemata. There was a constant comparison of the segments within and across categories in order to clarify the meanings of each category. In order to ensure an even greater evidence of construct validity, data collection was conducted throughout the research treatment, to a point of theoretical saturation.

The difference in treatment between the two groups was the implementation of instructional strategies that incorporated constructs of students' SCCS (*Figure 1*), and strategies that did not incorporate these constructs (*Figure 2*). Data collection from both groups was conducted whenever a lesson intentionally includes constructs of students' SCCS in the first group. This helped to ensure a greater level of internal validity regarding relations between the constructs of students' SCCS and levels of expertise. The data collection also used unobtrusive measures to help strengthen the validity and reliability of the observational data. For example, students' verbal, visual and/or textual representations of their mental models, as well as tests and essays, were routinely included as part of the lesson plans so that these incidents would not be viewed as separate events outside of the regular classroom activities.

Finally, the study also produced an audit trail to strengthen its internal validity. This provided evidence of all raw data sources and methods. It also provided documents of the data reduction and analysis, such as the segmented and coded databases, as well as instrument-development information. In addition, it included representative samples of process notes, lesson plans, tests, and essay questions.

Methodology Limitations

This mixed methodology study used *t* tests to determine any significant differences between the participants' entry-level abilities, and any significant differences in test scores resulting from participants' exposure to SCCS instructional strategies. A possible limitation of using *t* tests is that, as the number of tests are increased, researchers run the risk of committing a Type I error (Gall, Gall, & Borg). Since only three classes were involved in the study, and since only three of the tests in the *Aeneid* unit were analyzed using *t* tests, the risk of committing a Type I error was minimized.

The study also used interpretational analysis to identify students' use of the expertise structures specified by the theory of expertise, and students' use of their SCCS. As noted in the qualitative study of Barab, Hay, and Yakmagata-Lynch (2001), the trustworthiness of developing coding schemes based on subjective interpretations "is certainly not a straightforward process" (p. 101). In addition, it can be difficult for researchers to resituate themselves into the momentary contextual dynamics of the classroom based on the data collected. In spite of these limitations, Barab, Hay, and Yakmagata-Lynch concluded that coding schemes can be particularly useful in creating a category database in order to obtain a broad look at elements, search for particular episodes, draw contrasts between groups, and discover characteristic themes in the data.

Another limitation of interpretation analysis is the need to amass large amounts of data regarding student-student, student-teacher, student-tools, and student-resource interactions. Capturing and analyzing this data is extremely labor intensive. Interrater reliability can also limit the usefulness of interpretational analyzes. To this end, the two teachers involved in the study separately coded several segments of video data, as well as several examples of students' illustrated and textual descriptions. The teachers then compared and calibrated their coding systems to ensure greater interrater reliability.

Data Analysis Procedures

This qualitative study used an analytic reporting style. These analyses included a thick description of the participants, events, and context of the study. For example, separate databases were created for the class receiving instruction using the SCCS instructional design, and the class using the traditional instructional design. Video transcripts, student-created illustrations and textual descriptions of their mental models were analyzed to identify constructs, themes and patterns that exhibited students' use of expertise structures, as shown in Appendix F. This analysis created a coded and segmented database of participants' expertise levels and structures (Appendix G). All data segments were also coded to represent participants' use of their social and cognitive-connectedness schemata (Appendix H). Finally, a measurement of the participants' ability to transfer concepts studied in the unit to other areas was conducted at the end of the unit (Appendix I).

After analyzing the classes' databases, a cross-group analysis was conducted making note of the consistencies as well as the differences in constructs, themes and patterns between the two groups. Display formats such as tables and figures were used to illustrate any consistencies or differences found between the two groups' use of expertise levels and structures, as well as the employment of their social and cognitive-connectedness schemata.

Summary

The way students learn changes as their learning tools change. Due to the affordances of technology, instructional designers need a more unified theory of learning that incorporates these changes. The SCCS instructional strategies suggested in *Figure 1* take into account the affordances of technology and its impact on students' social and cognitive-connectedness schemata. This study examined how and to what extent such instructional strategies facilitate transfer when compared with instructional strategies that do not target constructs of students' social and cognitive-connectedness schemata.

CHAPTER 4: DATA COLLECTION AND ANALYSIS

Introduction

The purpose of the study was to examine how and to what extent online instructional design strategies that facilitate students' social and cognitive-connectedness schemata affect learning transfer in K-12 education. The study examined the question, "How and to what extent will online instructional design strategies that facilitate students' social and cognitive-connectedness schemata affect learning transfer in K-12 education?" The study was limited to the experimentally accessible sample population of 6th grade students in a suburban middle school setting.

Students from three different 6th grade Language Arts classes participated in this study. The sample of this experimentally accessible population all attended the same middle-class, suburban public school in San Jose, California. Class A had 27 students; 16 boys and 11 girls. Class B was comprised of 29 students; 15 boys and 14 girls. Class C had 23 students; 11 girls and 12 boys. Out of these three groups, the participants in Class A and Class B were randomly chosen to receive instruction targeting the constructs of their social and cognitive-connectedness schemata, as outlined in Appendix D. Students in Class C received instruction using traditional instructional strategies, as outlined in Appendix E.

Data Collection Methods

In order to examine how and to what extent the different instructional strategies might affect students' ability to transfer learning, each class received eight weeks of instruction based on a study of the *Aeneid*. During this time, both quantitative and qualitative data was collected that reflected students' use of their SCCS, as well as their use of expertise structures. Data was collected from class discussions, students' videotapes, illustrations and textual representations of students' mental models, blogs, online review games, tests, essays, and students' interactions in the online virtual world game of Rome KaMOO. The quantitative data examined students' entry-level abilities in Language Arts by conducting *t* tests of the classes' CST (California Standardized Test) scores. These annual tests include assessing students' Language Arts abilities in the areas of word analysis, reading comprehension, literary response and analysis, writing strategies, and written conventions. Participants took these tests at the end of their 5th grade year in 2006. The CST's provided a valid base of comparison in order to determine levels of significant differences between the classes' entry-level Language Arts abilities in these areas. In order to accept or reject the null hypothesis, *t* tests were then later conducted of the classes' tests and essay scores halfway through the *Aeneid* unit, and at the end of the unit in June 2007. Comparisons were then made between the classes' *Aeneid* scores with and without the SCCS treatment, and the classes' Language Arts entry-level scores. If no significant difference existed between the classes' entry-level Language Arts abilities and their final test scores, the null hypothesis would be accepted.

Using interpretational analysis, qualitative data was segmented, tagged, and coded according to the variables specified by the theory of expertise, and the constructs of students' social and cognitive-connectedness schemata. Using analytic induction, differences were noted between the groups' uses of their SCCS and expertise structures. Results from these analyses were then compared with any significant differences in the classes' tests and essay scores and with any significant differences found in their Language Arts entry-level abilities. The null hypothesis predicted that the instructional design strategies facilitating schema acquisition would not increase levels of learning transfer. The null hypothesis also predicted that any differences noted in the students' test and essay scores would be comparable to any differences found in their Language Arts entry-level abilities, whether or not students received instruction targeting their SCCS.

Quantitative Methods

Fifth grade Language Art scores from the classes' California Standardized Test (CST) were analyzed to note any significant differences. This provided a base of comparison between the groups' 6th grade Language Arts entry-level abilities. An answer to the research question, "How and to what extent will online instructional design strategies that facilitate students' social and cognitive-connectedness schemata affect learning transfer in K-12 education?" could not be answered until any significant differences in the participants' entry-level skills for Language Arts were known.

As shown in Table 1, a statistically significant *p* value of 0.0205* was found after a *t* test was conducted for Class A and Class B's entry-level CST scores. Class B had a higher mean. Since both groups received the SCCS instructional treatment, it was anticipated that final test results would also show a statistically significant *p* value, with Class B receiving a higher mean score.

Table 1: Fifth Grade Language Arts CST Data for Class A and Class B

5^{th} Grade LA CST Scores	Mean	*SD*	*SEM*	*N*	*p* value
Class A	377.52	51.92	9.99	27	
Class B	409.31	47.71	8.86	29	
t = 2.3879					
df = 54					
T Test Result:					0.0205*

A *t* test of Class A and Class C's CST scores produced a *p* value of 0.0999, as shown in Table 2. This indicated that the two classes had similar entry-level abilities in Language Arts. Even though Class C had a slightly higher mean, the difference did not reach significance. In the research study, Class A would receive the SCCS instruction, and Class C would receive traditional instruction. It was anticipated that, assuming the null hypothesis, there would also be no significant differences between Class A and Class C's final scores.

Table 2: Fifth Grade Language Arts CST Data for Class A and Class C

5th Grade LA CST Scores	Mean	*SD*	*SEM*	*N*	*p* value
Class A	377.52	51.92	9.99	27	
Class C	402.9	52.22	11.40	21	
t = 1.6793					
df = 46					
T Test Result:					0.0999

A *t* test of Class B and Class C's CST score revealed a *p* value of 0.6569. This difference is considered to be not statistically significant (Table 3). The null hypothesis predicted there would also be no significant difference between Class B and Class C's final test scores.

Table 3: Fifth Grade Language Arts CST Data for Class B and Class C

5th Grade LA CST Scores	Mean	*SD*	*SEM*	*N*	*p* value
Class B	409.31	47.71	8.86	29	
Class C	402.95	2.22	11.40	21	
t = 0.4470					
df = 48					
T Test Result:					0.6569

Using the results from these *t*-tests, classes that had a statistically valid comparison base could then be analyzed to determine any statistical difference between the classes' *Aeneid* unit tests scores when exposed to either traditional instructional strategies, or instruction that facilitated the use of their SCCS. To make this comparison, students in Groups A, B, and C all took a review test halfway through the eight-week *Aeneid* unit, and a final test and essay exam at the end of the unit. If the instructional strategies had little or no effect on students' learning, the null hypothesis predicted there would be little or no difference between the classes' entry-level differences, and the classes' midpoint and final exam score differences. Table 4 provides raw data comparisons of students' midpoint Review Test scores and Final Test and Essay scores.

Table 4: Tests and Essays Mean Scores for *Aeneid* Tests

Measures	Class A	Class B	Class C
Review Test /50	46.8	45	38.8
Final Test /60	49.2	53	50.9
Final Essay Scores /32	18.3	25	16.2

Tables 5-7 show test results for the classes' midpoint Review Test, consisting of 50 objective questions. A comparison between Class A and Class Bs' midpoint *Aeneid* Review Test score (both classes received SCCS instruction) revealed a statistically significant *p* value of .0090**, as shown in Table 5, with Class A having a higher mean than Class B. This is a statistically significant difference when compared to the classes' entry-level CST scores. On the CST, Class B had a statistically significant higher score. Even though both Class A and Class B received SCCS instruction, the SCCS strategies facilitated learning transfer more for the lower entry-level class than it did for the higher entry-level class, at least on the midpoint Review Test. This finding rejects the null hypothesis, that instructional design strategies that facilitate schema acquisition will not increase levels of learning transfer. In this case, the SCCS strategies increased levels of learning transfer for the lower-entry level class.

Table 5: *T* Test Results for Class A and Class Bs' *Aeneid* Review Test Scores

Aeneid Review Test	Mean	*SD*	*SEM*	*N*	*p* value
Class A/50	48.58	1.77	0.35	26	
Class B/50	44.97	6.57	1.22	29	
t= 2.7132					
df = 53					
T Test Result:					0.0090**

A *t* test for Class A and Class Cs' mid-point *Aeneid* Review Test scores revealed a statistically significant *p* value of 0.0001** as shown in Table 6, with Class A showing a higher mean. Class A had received instruction targeting students' use of their SCCS. Class C received traditional instruction. These results support the hypothesis that instructional design strategies that facilitate schema acquisition will increase levels of learning transfer, at least for the mid-point Review Test. This statistically significant result is reinforced even more by the fact that Class C had a higher entry-level ability in Language Arts that did Class A, and yet, after the SCCS instruction, Class A scored higher than Class C on the mid-point Review Test.

Table 6: *T* Test Results for Class A and Class Cs' *Aeneid* Review Test Scores

Aeneid Review Test	Mean	*SD*	*SEM*	*N*	*p* value
Class A	48.58	1.77	0.35	26	
Class C	38.75	9.40	2.10	20	
t= 5.2299					
df = 44					
T Test Result:					0.0001**

A *t* test for Class B and Class Cs' mid-point *Aeneid* Review Test scores showed a statistically significant *p* value of 0.0089** as shown in Table 7, with Class B having a higher mean. The null hypothesis had predicted the classes would have no significant difference, since their entry-level abilities were not significantly different. This indicates that the SCCS instructional strategies had a positive impact on Class B's performance, since the only treatment differences were that Class B received SCCS instruction and Class C received traditional instruction.

Table 7: *T* Test Results for Class B and Class Cs' *Aeneid* Review Test Scores

Aeneid Review Test	Mean	*SD*	*SEM*	*N*	*p* value
Class B	44.97	6.57	1.22	29	
Class C	38.75	9.40	2.10	20	
$t = 2.7286$					
df = 47					
T Test Result:					0.0089**

A *t* test for Class A and Class Bs' *Aeneid* Final Test scores was not statistically significant, revealing a *p* value of 0.1483 (Table 8). This contrasts with the groups' entry-level scores, which did show a statistically significant difference. On their entry-level scores, Class B's mean was greater than Class A's mean, with a statistically significant *p* value of 0.0205*. Since both groups received the SCCS instructional treatment, this suggests that the SCCS instruction helped to close the performance gap between the lower-performing students in Class A and the higher performing students in Class B.

Table 8: *T* Test Results for Class A and Class Bs' *Aeneid* Final Test Scores

Aeneid Final Test	Mean	*SD*	*SEM*	*N*	*p* value
Class A	49.19	11.72	2.26	27	
Class B	53.21	8.68	1.61	29	
t= 1.4664					
df = 54					
T Test Result:					0.1483

A *t* test for Class A and Class Cs' *Aeneid* Final Test scores was not statistically significant, showing a *p* value of 0.5874 (Table 9), with Class C receiving slightly higher scores. This contrasts slightly with the classes' entry-level score differences, which showed a *p* value of 0.0999, in favor of Class C. Class A had received instruction targeting students' use of their SCCS, while Class C had received traditional instruction. The difference between the two *p* values could indicate that the SCCS treatment helped students in Class A perform slightly better on the Final Test than the null hypothesis would have predicted.

Table 9: *T* Test Results for Class A and Class Cs' *Aeneid* Final Test Scores

Aeneid Final Test	Mean	*SD*	*SEM*	*N*	*p* value
Class A	49.19	11.72	2.26	27	
Class C	50.90	9.52	2.08	21	
$t = 0.5464$					
df = 46					
T Test Result:					0.5874

The *t* test for Class B and Class Cs' *Aeneid* Final Test scores was not statistically significant, returning a *p* value of 0.3784, as shown in Table 10. The classes' entry-level differences showed a *p* value of 0.6569, which was also not statistically significant. The classes had similar entry-level abilities, and the fact that Class B received SCCS instructional strategies and Class C received traditional instruction did not significantly affect their objective test scores. This finding supported the null hypothesis that instructional strategies facilitating schema acquisition would not increase levels of learning transfer.

Table 10: *T* Test Results for Class B and Class Cs' *Aeneid* Final Test Scores

Aeneid Final Test	Mean	*SD*	*SEM*	*N*	*p* value
Class B	53.21	8.68	1.61	29	
Class C	50.90	9.52	2.08	21	
t= 0.8890					
df = 48					
T Test Result:					0.3784

Finally, *t* tests were conducted to compare all of the classes' scores on the *Aeneid* Final Essay. Tables 11-14 illustrate these results. Participants wrote two paragraphs for each of the four themes discussed in the *Aeneid* (see Appendix I). The rubric was specifically designed to assess students' objective knowledge as well as their higher-order thinking skills and learning transfer abilities.

Class A and Class Bs' *Aeneid* Final Essay score comparisons revealed a statistically significant difference, with a *p* value of 0.0006** (Table 11). Class B had a higher mean. Both classes received instruction targeting students' use of their SCCS. No hypothesis had been made regarding classes that both received SCCS instruction, although it was anticipated that any difference between the classes' scores would be similar to the difference in their CST scores. The classes' CST score differences revealed a significant *p* value of 0.0205*, with Class B showing a higher mean.

Table 11: *T* Test Results for Class A and Class Bs' *Aeneid* Final Essay Scores

Aeneid Final Essay Scores	Mean	*SD*	*SEM*	*N*	*p* value
Class A	18.73	8.45	1.61	26	
Class B	25.96	5.88	1.11	28	
t= 3.6749					
df = 52					
T test result:					0.0006**

The *t* test for Class A and Class Cs' Final Essay scores was not statistically significant, returning a *p* value of 0.2634, as shown in Table 12. Class A had a higher mean. Class A received instruction targeting students' use of their SCCS and Class C received traditional instruction. Although the difference in the classes' scores did not reach significance, it is important to note that Class A had a lower mean than Class C on the entry-level CST test, but a higher mean on the Final Essay. Since the *t* test results shown in Table 12 did not reach significance, Class A and Class C's Final Essay score difference accepts the null hypothesis.

Table 12: *T* Test Results for Class A and Class Cs' *Aeneid* Final Essay Scores

Aeneid Final Essay Scores	Mean	*SD*	*SEM*	*N*	*p* value
Class A	18.73	8.45	1.66	26	
Class C	16.19	6.51	1.42	21	
t= 1.1325					
df = 45					
T Test result:					0.2634

A *t* test for Class B and Class Cs' Final Essay scores yielded a statistically significant *p* value of 0.0001**, as shown in Table 13. Class B had a higher mean. Class B received instruction targeting students' use of their SCCS. Class C received traditional instruction. Since the two classes did not have a statistically significant difference on their entry-level scores, this finding rejects the null hypothesis.

Table 13: *T* Test Results for Class B and Class Cs' *Aeneid* Final Essay Scores

Aeneid Final Essay Scores	Mean	*SD*	*SEM*	*N*	*p* value
Class B	25.96	5.88	1.11	28	
Class C	16.19	6.51	1.42	21	
t= 5.5013					
df = 47					
T Test result:					0.0001**

Table 14 summarizes and compares results from the classes' CST entry-level test, the *Aeneid* midpoint Review Test, the Final Test, and the Final Essay.

Table 14: *T* Test Summaries and Comparisons

CST Entry-Level	A<B	A=C	B=C
Midpoint Review Test	A>B	A>C	B>C
Final Test	A=B	A=C	B=C
Final Essay	A<B	A>C	B>C

Summary of Quantitative Data

The quantitative data analyzed in this study focused on the aspect of the research question that asked, “To what extent will online instructional design strategies that facilitate students’ social and cognitive-connectedness schema affect learning transfer?” To this end, scores were compared between classes receiving SCCS instruction and classes receiving traditional (non-SCCS) instruction. Comparisons were made of the classes’ midpoint *Aeneid* Review Test, the Final Test, and the Final Essay exam. The midpoint Review Test had 30 fill-in questions. All of the students were allowed to use their notes and the *Aeneid* text during the test. Class A and Class B had received instruction facilitating their SCCS. Class A and Class B had a statistically significant difference in their entry-level Language Arts abilities, with Class B scoring higher than Class A on the CST (p value 0.0205*). Halfway through the unit study of the *Aeneid*, however, Class A and Class B had a very significant difference in their Review Test scores, with Class A scoring higher than Class B. The t test revealed a p value of 0.0090**. This shows that the SCCS instruction had a greater impact on the lower entry-level ability students in Class A than it did on the higher entry-level ability students in Class B, at least on the midpoint Review Test.

A comparison of the Language Arts entry-level abilities of Class A students (SCCS instruction) and Class C students (non-SCCS instruction) did not show a statistically significant difference, although Class C’s mean score was higher. On the midpoint Review Test, however, the two classes had an extremely significant difference in their scores, with Class A having a higher mean than Class C. A t test of the midpoint Review Test revealed a *p* value of 0.0001**. Students in Class A had received instruction that facilitated their SCCS, while Class C students had received traditional instruction. This evidence showed that the SCCS instruction positively impacted student performance, at least on the objective midpoint Review Test.

Class B and Class C students did not have a statistically significant difference in their entry-level Language Arts abilities. On the midpoint Review Test, however, a *t* test revealed a significant *p* value of 0.0089**, with students in Class B scoring higher than students in Class C. Class B students received instruction that facilitated their SCCS. Class C students received traditional instruction. This finding also supported the premise that SCCS instruction would positively impact student performance.

The *Aeneid* Final Test had 29 fill-in questions, and one multiple-choice question. Students in Class A and Class B did not have any statistically significant difference in their Final Test scores, however, Class B students had a slightly higher mean than students in Class A. The two classes had shown a statistically significant difference in their entry-level Language Arts abilities, with students in Class B evidencing a higher Language Arts aptitude. During the *Aeneid* unit, both classes received instruction that facilitated their SCCS use. This indicates that, at least on the objective Final Test, the SCCS instruction helped to narrow the gap between the two classes' Language Arts abilities, bringing the lower entry-level ability students up to a more equitable level.

Students in Class A received slightly higher scores than students in Class C on the Final Test, however the difference was not statistically significant. Class A received instruction facilitating their SCCS, and Class C received traditional instruction. The classes did not have a significant difference in their entry-level Language Arts abilities, although Class C showed a higher mean on the entry-level test. Since there was not a statistically significant different between Class A and Class C's scores on the objective Final Test, it cannot be conclusively stated that the SCCS instruction positively impacted Class A's performance on the Final Test.

There also was not a statistically significant difference between Class B and Class C's scores on the Final Test. They also had not shown any statistically significant difference in their entry-level Language Arts abilities. Class B students had received instruction facilitating their SCCS, and Class C students had received traditional instruction. Since there was not a significantly statistical difference on their entry-level abilities or on their Final Test scores, it cannot be conclusively stated that the SCCS instruction positively impacted Class B's performance on the Final Test.

The Review Test and Final Test were designed to assess students' factual knowledge and understanding of the *Aeneid.* The Final Essay exam, however, was designed to assess students' learning transfer abilities. The Final Essay required students to respond to four enduring themes discussed throughout the unit (see Appendix I). Students had to explain each theme, provide examples from the *Aeneid* that illustrated each theme, and then discuss present-day examples relating to each theme. Class A and Class B had shown a statistically significant difference in their entry-level Language Arts abilities, with Class B scoring higher than Class A on the CST (p value of 0.0205*). Class A and Class B also had a significant difference in their Final Essay scores (*p* value of 0.0006**), with Class B once again having a higher mean. It appears that, while the SCCS strategies helped to narrow the gap between Class A and Class B's performance on the objective tests, the SCCS strategies impacted the higher entry-level students' scores more on the final essay. Additional research must be conducted to provide more conclusive data.

There was not a significant difference between Class A and Class C's Language Arts entry-level abilities (CST scores). Likewise, there was not a significant difference between Class A and Class C's Final Essay scores. Class A had received SCCS instruction and Class C had received traditional instruction. Even though there was not a significant difference between Class A and Class C's Final Essay scores, Class A did show a higher mean than Class C on the Final Essay scores. This contrasts with the fact that Class C had a higher mean on the classes' entry-level scores. These differences cannot be conclusively attributed to the implementation of SCCS instructional strategies without further research.

Class B and Class C's performance on the Final Essay exam did show a statistically significant difference. The two classes did not have a statistically significant difference in their entry-level abilities (*p* value of 0.6569), but on the Final Essay, a *t* test showed a significant *p* value of 0.0001*, with participants in Class B receiving higher scores. Since Class B received the SCCS strategies and Class C did not, this finding supports the hypothesis that instructional design strategies that facilitate schema acquisition will increase levels of learning transfer.

Overall, the quantitative research results showed that students receiving the SCCS instructional strategies had higher scores on the midpoint Review Test than students who did not receive SCCS strategies. The objective Final Test scores indicated that the SCCS strategies helped to narrow the gap between the lower entry-level students' scores and the higher entry-level students' scores. The Final Essay exam scores showed that the SCCS strategies improved the test scores of the higher entry-level group (Class A) when compared to the scores of the other higher entry-level group (Class C) that did not receive the SCCS strategies.

Presentation of Qualitative Data

The research question asked in this study was, "How and to what extent will online instructional design strategies that facilitate students' social and cognitive-connectedness schemata affect learning transfer in K-12 education?" The quantitative data analyzed in this study focused on the aspect of the research question that asked to what extent will online instructional design strategies that facilitate students' social and cognitive-connectedness schema affect learning transfer. The qualitative data collected in the study addressed the part of the research that asked how will online instructional design strategies that facilitate students' social and cognitive-connectedness schema affect learning transfer. Qualitative data was collected from class discussions, video recordings, illustrations and textual representations of students' mental models, blogs, video clips, and textual logs of students' interactions when playing the online virtual world, Rome KaMOO. Using interpretational analysis, the data was segmented according to the variables specified by the theory of expertise, and the constructs of students' social and cognitive-connectedness schemata. Analytic induction was used to relate the constructs of students' social and cognitive-connectedness schemata with levels of expertise.

Coding for Students' Use of the Variables Specified by the Theory of Expertise

Since requirements for transfer tasks are most often found in higher levels of expertise, a database was created to reference student phenomenon regarding the expertise variables of knowledge structures, cognitive functions, and mental representations. In order to identify and categorize instances of students' use of these structures, students' levels of expertise were divided into three categories: novice, intermediate, and advanced. Category labels and definitions for each type of phenomenon analyzed in the database are illustrated in Appendix F. For example, instances of students gaining knowledge through concrete information and surface features were labeled as novice levels of expertise for the construct of knowledge structures. Students who organized knowledge using accessible structures, such as mental representations, characterized intermediate levels of knowledge use. This included examples of students who moved from searching for information to searching for rules, or principles. Students who faced problems and challenges addressing their current knowledge and competency, and then reorganized their existing knowledge to connect with new concepts, provided evidence of an advanced level of expertise for the construct of knowledge structures. The database coded these phenomena as KS1 (knowledge structures, novice level), KS2 (knowledge structures, intermediate level), or KS3 (knowledge structures, advanced level). The same procedure was used to code levels of cognitive functions and mental representations.

Appendix G illustrates how these expertise structures and constructs were coded and correlated with student input.

Lines 16-19 of the database provide an example of how the data was segmented, tagged, and coded according to the variables specified by the theory of expertise. These lines contain a transcription of a video clip taken during a class session in Class A.

> (Line 16) Teacher comments to Student E: "Right, get his permission because it was done on the ocean. So how would you answer number 8? Why is Neptune upset with Aolus?"
> (Line 17) Student E, fidgeting, and in a frustrated, irritated voice answers, "I don't know."
> (Line 18) Teacher: "Because, as S was just saying, the ocean was Neptune's territory, and Aolus caused the wind on the ocean because Venus asked him to, but he didn't get permission from Neptune."
> (Line 19) Student E, with eyes opened a little wider: "Ohhh." Student E began to write her answer on her paper.

Line 17 was tagged as an example of KS0 because Student E could not deduce any inference from the provided facts. Line 19 was tagged as an example of KS1, because, after a short discussion, Student E now provided evidence of using a knowledge structure at a novice level.

Coding for Students' Use of Social-Connectedness Constructs

After coding the data for students' use of variables specified by the theory of expertise, the data was then coded to show students' use of their social-connectedness schema constructs. Constructs of students' social-connectedness schema included their ability and preference to link up with others who had knowledge they wanted to obtain, especially digital knowledge. It also included their desire to "lurk" and to watch others who knew how to do what they wanted to do. Students' third social-connectedness construct was their ability and desire to “lunge”; to eagerly jump in and try new things, especially if it included a technology component. The database respectively coded phenomena of students’ social-connectedness schema as SC1 (social-connectedness schema of link), SC2 (social-connectedness schema of lurk), or SC3 (social-connectedness schema of lunge). For example, a video clip from Class B was transcribed and segmented as lines 22-40 in the database. Each line was tagged as an instance of students using their social-connectedness schema. Specifically, line 22 states, “A group of girls all appear to be talking to each other at the same time and look confused. Teacher: ‘What’s the question you’re trying to answer?’” This line was tagged as SC1. The teacher linked up with the group of students. After a brief discussion between the students and the teacher regarding the question and possible answers, line 39 recorded that the teacher asked, “Ahh, what about the rest of you? Do you think he had any doubts about his future conquest?” Line 40 of the database then described the actions of one student in the group who had not yet participated in the discussion.

> (Line 40) She looked up and cocked her head to the left. She rested her left elbow on her desk, holding her chin in the palm of her left hand, and bit her left little finger’s fingernail. Her right arm lay outstretched on her desk as she held her pencil upward between her right thumb and index finger.

This segment (line 40) was coded as SC2. Even though the student did not yet quite understand the answer to the question, her body language indicated that she wanted to continue “lurking” on the edge of the discussion, listening for clues that would help her understand.

Students' participation in the online virtual world game of the Rome KaMOO also provided many instances of students' social-connectedness schema use. The game was designed in conjunction with the unit study of the *Aeneid*, so all three classes participated in the virtual world. The game was specifically created to help facilitate students' use of their social-connectedness schema. For this reason, Class A and Class B participated in the virtual world game before taking the Final Essay exam, while students in Class C played the online game after completing the Final Essay exam. Lines 138 and 139 in the database described the actions of students in Class B during their online virtual world gameplay. Segments from this transcribed video clip were tagged as evidencing SC3 behaviors, relating to their social-connectedness schema of "lunge". In these video clips, students actively engaged in the virtual world, interacting with other students, with their knowledge of the *Aeneid*, and with the game itself.

> (Line 138/V05CB) The student role-playing the character of Aeneas madly types his communication in the online virtual world, hoping to make wise decisions, communicate with others, and accumulate his chosen coins as quickly as possible.

> (Line 139/V05CB) Students role-playing Venus had difficulty logging in to the game, but are now fully engaged, helping each other with the codes to move their character around in the virtual world. Venus 1 intensely directs his partner, "Type @ go."

Coding for Students' Use of Cognitive-Connectedness Schema Constructs

Phenomena was also tagged that reflected students' use of cognitive-connectedness schema constructs. These constructs included navigation literacy, a preference for interactive/discovery-based learning, and the ability to make reasoned judgments based on a plethora of resources. Lines 60 and 61 of the database described incidents of students using their cognitive-connectedness schema.

> (Line 60/gif1CA) Picture of M intently working during class time, playing an online game of Hangman in order to study vocabulary words for a Chapter 4 test. Students had a choice to study at their desks or to study using the online games.

The picture described in line 60 provided evidence of students using their cognitive-connectedness schema construct of a discovery-based learning preference (CC2), since they chose to study by playing the online Hangman game instead of working alone at their desks.

The picture described in line 61 provided evidence of students employing all three constructs of their cognitive-connectedness schema: navigation literacy, a preference for discovery-based learning, and an ability to make reasoned judgments based on a plethora of resources (CC1, CC2, CC3).

> (Line 61/gif2CA) Picture of C intently looking at his list of vocabulary words to find the right word indicated by the Hangman clues.

Database line 145 described a picture of a student that was used in the online virtual world. This picture was tagged as an example of students' cognitive-connectedness schema of discovery-based learning (CC2). Students in the online

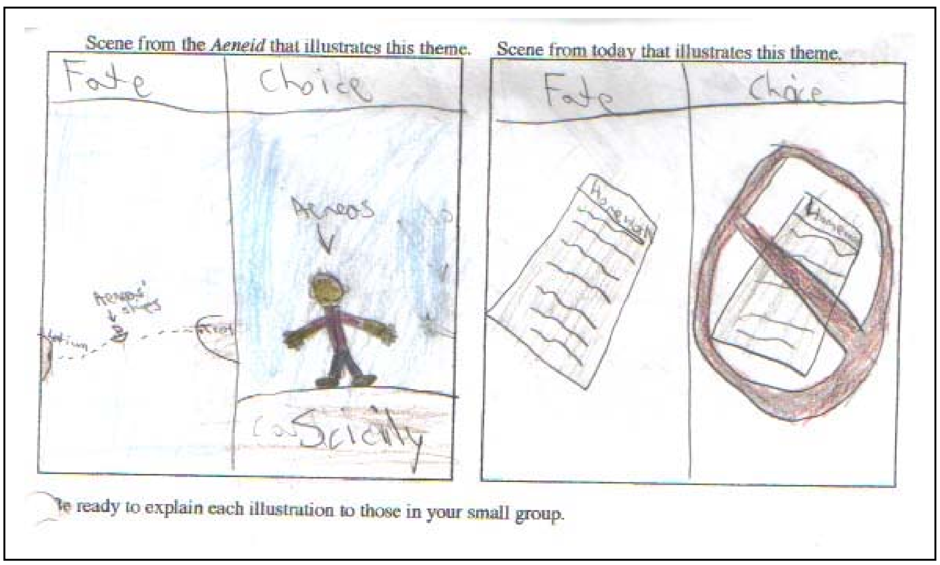
virtual world had their pictures taken to identify the character they role-played online. Using Photoshop, students helped to create these images by adding pictures of ancient Rome and Greece in the background.

In addition to tagging and coding students' use of expertise structures and SCCS, the database was also coded to reference the date, class (A, B, or C), student identification number, and type of input (video transcript, student illustration, textual description, test, essay, gameplay) recorded in each data segment. A chart of database code definitions is included in Appendix J.

Summary of Qualitative Data

The qualitative data analyzed the question of how the facilitation of students' SCCS would affect learning transfer. Appendix D outlines lesson plans used in Class A and Class B's instruction. Class A and Class B received instruction that facilitated the use of their social and cognitive-connectedness schemata. Class C's instruction implemented traditional instructional strategies, as shown in Appendix E. At the end of the eight-week unit, samples from video recordings, notes from class discussions, students' responses to tests, quizzes, and essays, as well as visual representations of students' mental models were transcribed and compiled into a single database. This database was then segmented and coded. Keyword searches were then conducted to identify phenomena that evidenced the use of advanced levels of expertise structures. Using analytic induction, this data was then analyzed to discover the conditions under which learning transfer may have occurred. A chart illustrating these correlations is included in Appendix K.

Some evidence of learning transfer (showing the use of an advanced level of at least one expertise structure) was found in all of the classes, and not every learning transfer phenomenon correlated with the use of a student's social or cognitive-connectedness schema. For example, lines 74-76 in the database all referenced advanced uses of students' mental representations. These students were all from Class C, which received traditional instructional strategies. Students were asked to draw a scene from the *Aeneid* that illustrated one of the four themes found in the *Aeneid*, and to then draw a scene from today that also illustrated their chosen theme. Included here is an illustration drawn by a student from Class C showing his mental representation of the theme fate vs. choice. In the far left column the student drew Aeneas' ships sailing away from Troy to Latium. He placed this under a column labeled Fate. He



then drew a picture of Aeneas in Sicily under the column Choice to show that, although it was Aeneas' fate to go to Latium, Aeneas first chose to go to Sicily. The student then drew the pictures on the right to illustrate that he felt it is was his personal fate to be given homework assignments, but that he also had a personal choice whether or not he did the assigned work. Examples such as these evidenced advanced levels of expertise, as defined in Appendix F. While there were some examples from Class C that evidenced advanced levels of expertise, there were no examples that exhibited the use of two or more expertise structures in any one incident.

Phenomena exhibiting advanced levels of at least two or more expertise structures in one incident were only found in data gathered from Class A or Class B. There were no examples of two or more expertise structures in any one incident in the data gathered from students in Class C. For example, all the phenomena referenced in lines 92-96 exhibited advanced levels of knowledge structures and cognitive functions. These samples are from Class A and Class B’s online blog.

> 92
> I think the phrase Might makes Right means that power will be the most important no matter what. An example of this from the *Aeneid* would be when Romulus kills Remus. Romulus is the hero because he was more powerful than Remus. It differs from Right makes Might. In Might makes Right you must be powerful to conquer, whereas in Right makes Might you have to be a good person. I agree with Right makes Might because I value doing the right thing over power.
> Thursday, April 19, 2007 - 08:05 PM
>
> 93
> If I was a soldier in Augustus Cesar's army, I would not want the *Aeneid*, but also want it. I would be glad to have a king who is related to a god, but if the *Aeneid* is written, we will gain power. If we gain a lot of power, Augustus might decide to conquer terretories around us, and since I am a soldier, I may die.
> Wednesday, April 25, 2007 - 11:39 AM
>
> 94
> I think the phrase Might makes Right means The stronger person, with might, (power strength), will always win. The *Aenied* relates to this story because Romulus and Remes, the brother who killed the other brother got power. Unlike this story in the Hebrew bible Cain and Abel, the brother who killed the weaker brother, the brother who got killed was the hero. It is a lot different than the Romans because Right makes Might means The right way is the power.
> Wednesday, April 25, 2007 - 11:47 AM

96
The quote, “culture is history in the present” is a great example of the blooming of our society. As you may understand, our culture plays a HUGE role in today's cities and societies. But one question remains: Where is the source of our culture? As you glance back at the previous quote, it explains the answer to that question. See, culture developed way back in history and then was later introduced to present times. Example: art and pottery were created and grown back in ancient civilizations. And today, there are still huge arrays of art and pottery across the country. So in reality, our past is our present.
Thursday, April 26, 2007 - 10:17 AM

Phenomena referenced in lines 127-130 all evidenced advanced levels of knowledge structures, cognitive functions, and mental representations. These excerpts are from either Class A or Class B’s Final Essay exam.

127
A) The *Aeneid* is an example of art influencing culture. This means that art is what creates our society; gives examples which can be inserted into our culture. An example of this is how the *Aeneid* was “evidence” that Augustus was Rome’s rightful ruler. It influenced how people thought and felt. When a form of art as such is consumed by culture, it eventually changes it.
B) An example of art influences culture not from the *Aeneid* may date back to the Macedonians. They admired the art of the Greeks and adopted it as their own.

128
A) Culture is history in the present means that our present society is made up of the culture of the past, and what our culture is now will effect the culture of the future. If you are referring to culture being social forms and customs being passed down through generations, then it is like when the Greeks attacked the Trojans and Aeneas took his family and gods with him when he fled. He was trying to preserve his culture. When they fought with the Latins, they were trying to rebuild their culture in the present. If you are referring to culture being art, then it is like the armor and weapons that Venus gave him. The shield is decorated with the entire future on it, and everything is made with super strong, indestructible material. This could show that art is indestructible too, and that it will be passed down through generations.
B) An example that is not from the *Aeneid* is like how our country went to war in the past to defend freedom (Nazis), and now we are back at war to defend

> our country against terrorism. They say we are protecting our culture and rights. If you are talking about art, then archeological digs and the artifacts they recover is history in the present.

> 129
> Might makes right versus right makes might is yet another thing implied in this ancient novel, the *Aeneid*, and throughout the history of Rome. Romulus killed Remus to create Rome, saying the Trojans/Romans value strength (might makes right). If you look at our culture, we think being honest and truthful is better than killing people. We hated president Nixon because he lied (not being right makes might) and we don't like people who murder others (might makes right). In court, the honest defendants don't get sent to jail.

As shown in these examples, and as outlined in Appendix K, students' learning transfer was best facilitated when students had opportunities to employ their social and cognitive-connectedness schemata. Although students in Class C did exhibit some advanced use of knowledge structure, cognitive functions and mental representations, they exhibited these in isolation, rather than in conjunction with the other expertise structures. The qualitative data shows that students' learning transfer was facilitated by the use of their SCCS to the extent that it enabled them to exhibit more than one advanced level of an expertise structure at one time. Students who did not receive SCCS instructional design strategies did not exhibit more than one advanced level of an expertise structure at one time.

CHAPTER 5: RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The purpose of the study was to examine how and to what extent online instructional design strategies that facilitate students' social and cognitive-connectedness schemata (SCCS) affect learning transfer in K-12 education. In order to answer this question, the study compared both quantitative and qualitative data gathered from participants in three different 6^{th} grade Language Arts classes. Two classes received instruction that facilitated the use of their social and cognitive-connectedness schemata, and one class received instruction utilizing traditional (non-SCCS) instructional strategies.

A quantitative study examined differences in the classes' 6^{th} grade entry-level Language Arts abilities as evidenced by their California Standardized Test (CST) taken at the end of 5^{th} grade. These results were compared with differences between the classes' May 2007 *Aeneid* test scores. This comparison was conducted in order to analyze any significant differences between the classes receiving SCCS instructional strategies and the class receiving traditional instruction. Qualitative data was also gathered to identify differences in students' transfer abilities, as evidenced by their use of expertise structures. Together, analyses of these data helped to answer the research question, "How and to what extent will instructional design strategies that facilitate students' social and cognitive-connectedness schemata affect learning transfer in K-12 education?"

Conclusions from the Data

The study hypothesized that students receiving SCCS instruction would evidence greater learning transfer than students who did not receive the SCCS instruction. The research data provided evidence to support this hypothesis. The study also provided data to help answer the research question, “How and to what extent will instructional design strategies that facilitate students’ social and cognitive-connectedness schemata affect learning transfer in K-12 education?”

Quantitative Data Conclusions

First, it was anticipated that participants receiving SCCS instructional strategies would perform better on the unit’s objective Review Test and Final Test than students who received traditional instruction. The quantitative data provided confirming evidence. Class A was taught using SCCS instructional strategies. Class A’s Review Test scores showed a statistically significant p value of 0.0001** when compared with Class C’s mid-point Review Test scores. Class C received traditional instructional strategies. The fact that students in Class A had slightly lower entry-level abilities in Language Arts than students in Class C made this finding even more significant.

Class B participants also received SCCS instructional strategies. A t test of Class B and Class C’s Review Test scores revealed a statistically significant p value of 0.0089**. Class C received traditional instruction. Since participants in Class B and Class C had no statistically significant difference in their entry-level scores, this finding also supported the premise that facilitation of students’ SCCS would positively impact students’ performance.

Data comparisons of students' Final Test scores also showed positive, albeit inconclusive, evidence that SCCS instruction positively impacted student performance. The Final Test scores for Class A (SCCS instruction) and Class C (traditional instruction) had no statistically significant difference, returning a *p* value of 0.5874. The score comparisons, however, evidenced a potential narrowing of the performance gap between participants in Class A and Class C. A *t* test of the two classes' entry-level CST scores had revealed a *p* value of 0.0999, with Class C showing a higher mean. Since these results are not statistically significant, however, further research needs to be done to gather more conclusive evidence.

The difference between the Final Test scores for Class B (SCCS instruction) and Class C (non-SCCS instruction) was also not statistically significant. Although Class B's Final Test results did show a higher mean than Class C's Final Test results, the results are inconclusive and warrant further study.

No hypothesis was made regarding any potential score differences between the two classes that received SCCS instruction (Class A and Class B). It was only anticipated that any resulting score differences would correlate with differences in the classes' entry-level abilities. This, however, was not the case. On the students' entry-level CST scores, Class A and Class B showed a statistically significant difference, with a *p* value of 0.0205*. Participants in Class A evidenced lower entry-level abilities in Language Arts than did the participants in Class B. Scores on the Review Test, however, showed opposite results. Class A had a higher mean than Class B on the Review Test, with a statistically significant *p* value of 0.090*. It is possible that the SCCS instruction proved to be more efficacious for the lower performing students than it was for the higher performing students. Another possible explanation for Class A's strong showing on the Review Test is the novelty effect. Research has shown that "novelty effects boost performance with new technologies in the short term, but tend to wear off over time" (Means et al., 1993, Chapter V, ¶4). Earlier in the 2007 school year, students in Class B had received SCCS instruction in a previous unit of study. The *Aeneid* unit was Class A's first exposure to SCCS instructional strategies. More long-term studies need to be conducted to provide more conclusive results. The novelty effect could also explain why, on Class A and Class B's Final Test, a *t* test showed no significance difference between the classes' scores, returning a *p value* of 0.1483. Class B had a higher mean of 53.21, compared to Class A's 49.19 mean. It is possible that the novelty effect of the SCCS instruction began to wear off for participants in Class A by the time they took the Final Test, resulting in a lower mean for Class A than for in Class B. It must also be kept in mind, however, that this Final Test score difference between Class A and Class B was not statistically significant, while the entry-level ability scores for Class A and Class B were statistically significant, with Class B receiving higher scores. It can be concluded that, in spite of a novelty effect, the SCCS instructional strategies did have a positive effect on Class A's Final Test scores.

In addition to anticipating that participants in Class A and Class B would have higher averages than participants in Class C on the units' objective tests, it was also anticipated that these participants would receive higher scores on the unit's Final Essay exam than the Class C participants. This also proved to be true. The Final Essay was designed to measure students' transfer abilities. Participants in Class A received the SCCS instruction, and had a higher mean on the Final Essay than did participants in Class C, who received traditional instruction. The fact that students in Class A scored slightly higher on the Final Essay becomes more significant when it is taken into account that students in Class A had slightly lower entry-level abilities in Language Arts than students in Class C. This seems to indicate that the SCCS instructional strategies did help to facilitate Class A students' learning transfer abilities on the Final Essay exam. It is possible, as previously stated, that some of Class A's improved performance, when compared to Class C's performance, could be attributed to the novelty effect of the SCCS instruction.

Unlike participants in Class A, however, SCCS instructional strategies were not a novelty for Class B participants. A comparison between Class B and Class C's Final Essay scores provided further support that facilitating students' SCCS would positively impact students' scores. Class B and Class C had no statistically significant difference in their entry-level scores, yet on their Final Essay scores Class B had a higher mean, with a statistically significant *p* value of 0.0001**.

Overall, an analysis of the quantitative data gathered in this study showed that use of SCCS instructional strategies affected learning transfer to the extent that it narrowed the gap between lower and higher performing students, especially on objective tests, and significantly increased students' learning transfer abilities. Students in Class A and Class B performed better than students in Class C, both on the objective tests as well as the Final Essay exam. In spite of a possible interference caused by the novelty effect, the quantitative data supports the hypothesis that instructional design strategies that facilitate schema acquisition will increase levels of learning transfer.

Qualitative Data Conclusions

An analysis of the qualitative data answered the question of how the SCCS strategies would affect learning transfer. Students' learning transfer ability was positively affected by strategies that intentionally facilitated their social-connectedness schema constructs of link, lurk and lunge. Student's learning transfer ability was also positively affected by strategies that intentionally facilitated schema constructs of navigation literacy, discovery-based learning, and opportunities to make reasoned judgments based on a plethora of resources. For example, the blogs created by students in Class A and Class B provided participants with opportunities to link with other students as they created and read each other's blogs. It also provided a forum where students could cognitively-connect with the enduring understandings found in the unit, putting their ideas into words, and then publish their ideas. Students in Class A and Class B who made use of the blogs also received higher scores on the Final Essay exam than did the students in Class C who did not blog. This is not evidence of a correlation between these two events. The students in Class A and Class B who chose to post blogs might have been students who would have scored high on the essay exam in spite of their blogs. However, it must be noted that students with similar entry-level scores in Language Arts who did not receive SCCS instruction, especially the opportunity to create blogs, received lower scores on the Final Essay exam, than those in Class C.

In addition to Class A and Class B's higher Final Essay scores, participants in Class A and Class B also exhibited higher levels of expertise throughout the unit of study. As previously noted, requirements for transfer include the use of knowledge structures, cognitive functions, and mental representations at advanced levels of expertise (Clark, 2003; Lupart, Marini, & McKeough, 1995; Mayer 1999). Participants in Class A and Class B exhibited higher levels of expertise throughout the unit, as reflected in Appendix K.

Limitations of the Study

The results of the study were limited to three Language Arts classes of 6th grade middle school students in a suburban, public school setting, so the findings can be generalized only in a limited way to a population that manifests similar characteristics. Classroom observations were limited to those made by the teachers while teaching the classes, artifacts created by students during class, and to video segments filmed by either the teachers or a student during class time. Documentary evidence of students' use of expertise structures and their social and cognitive-connectedness schemata is limited by the scope of these observations.

Significance of the Findings

The results of this study indicate that SCCS instructional design strategies affected learning transfer to the extent that they narrowed the gap between lower and higher performing students, especially on objective tests, and significantly increased students' learning transfer abilities as evidenced by the Final Essay score comparisons. The results also showed that correlations exist between the use of expertise structures and the facilitation of students' social and cognitive-connectedness schemata. These results suggest that the affordances of today's technologies have effected changes in students' social and cognitive-connectedness schemata. As Reigeluth and Frick suggested, "More theories are sorely needed to provide guidance for additional kinds of learning and human development. . . . including the use of new information technologies as tools" (1999, p. 633). The findings of this study warrant the investigation of a new learning theory based on the existence of students' new social and cognitive-connectedness schemata. Finally, the successful integration of Mayer's SOI model, van Merriënboer, Kirschner, and Kester's 4C/ID model, Wiggins and McTighe's understanding by design model, along with game design elements, warrants more investigation to validate the formation of a SCCS design model, as illustrated in *Figure 1*.

Recommendations for Future Research

In order to further investigate and articulate the existence of a new learning theory based on students' SCCS, and to formalize the strategies used in this study into a valid instructional design model, more formative research is needed. Formative research seeks to create an accurate application of an instructional-design theory or model so that any weaknesses found in the application will reflect weaknesses in the theory. Conversely, any improvements made in the application will reflect ways to improve the theory (Reigeluth and Frick, 1999).

Future research should also include participatory designs that are iterative, distributed, and evolving, as suggested by the research of Barab, Thomas, Dodge, Carteaux, and Tuzun (2005). For example, future studies could specifically target at risk students, designing iterations to include students as active participants, not merely passive objects of the research. In addition to specifically targeting at risk students, future studies should also include students from varied social and economic backgrounds, in a wide variety of educational settings. These studies should include students who are exclusively in an online situation, as well as students who are in a mixed, (face-to-face as well as online) instructional setting.

In conclusion, the affordances of today's technologies have effected changes in students' social and cognitive-connectedness schemata. The formation of new social and cognitive-connectedness schemata calls for instructional design strategies that reflect these changes. It's time for instructional designers to stop describing parts of the elephant, and to start synthesizing "their findings into a picture of the whole beast" (Schaller &Allison-Bunnell, 2003 p. 3).

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APPENDIX A. *AENEID* ONLINE VIRTUAL WORLD

The *Aeneid* Rome KaMOO is an online virtual world created by Marie Sontag, located at: http://kamoo.dragonangel.net. The KaMOO is a free, educational MOO environment created by Dr. Kip Leland, Project Manager of L.A. Virtual Academy.

The right side of the KaMOO's screen describes the student's location, such as Carthage, Sicily, etc. It can also describe the characters or items found at that location, provide links for traveling to other locations within the KaMOO, display pictures, play sound, video, or hyperlink players to other Webpages. The left side of the screen keeps a running dialogue of conversations at that location. Students type their interactions in the bottom left corner. Students must use word processing skills in order to interact in the KaMOO. They must also move to various locations and make decisions that will help them reach their goals.

The *Aeneid* Rome KaMOO relates to content standards for 6th grade language arts and social studies. Before participating in the online world, students read an abridged version of the *Aeneid*, then role-play one of the story's characters and interact with the other players in search of quests. The *Aeneid* Rome KaMOO was designed to provide students with an immersive learning environment that could engender complex, transferable learning outcomes. This virtual world integrates the ideas of:

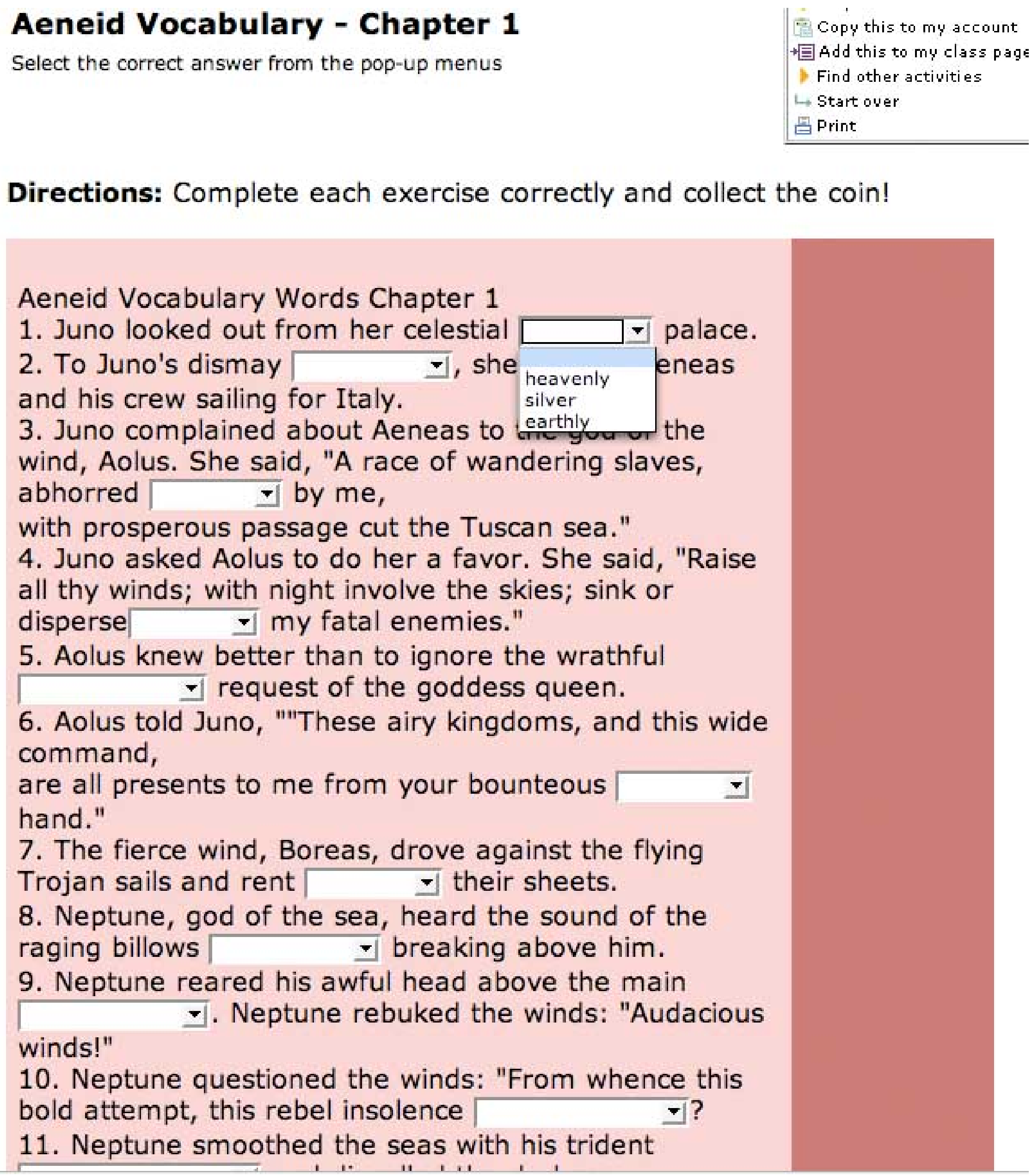
1. Four-Component Design Model (van Merriënboer, Kirschner, and Kester, 2003)
2. Cognitive Load Theory (Mayer and Moreno, 2003)
3. Understanding by Design (Wiggins and McTighe, 1998)
4. Social and Cognitive Connectedness Schemata (Sontag, 2006)

After studying the unit of the *Aeneid* and participating in the virtual world, students should be able to give examples from the story that illustrate the following enduring understandings.

1. culture is history in the present
2. fate vs. personal choice
3. right vs. might
4. art reflects culture vs. art influences culture

APPENDIX B. ONLINE VOCABULARY GAME

Students can study the *Aeneid* vocabulary words from chapter 1 by going to this site: http://www.quia.com/cz/12774.html



APPENDIX C. ONLINE *JEOPARDY!* POWERPOINT GAME

The Gods and Goddesses *Jeopardy!* PowerPoint Game can be used as a whole-class game, or played by individual students. It is available online for download at: http://kamoo.dragonangel.net/~marie/kamoowbpg/Gods_GoddessJepdy.ppt

APPENDIX D. LESSON PLANS USED FOR CLASS A AND CLASS B

Lesson Plans– SCCS Strategies

Aeneid Introduction

1. Familiarize yourself with the Teacher Tips and Directions. As with all the documents referred to in these plans, all of these documents can be downloaded from the hot-linked lesson plans at http://kamoo.dragonangel.net/~marie/kamoowbpg/Aeneid Lesson Plans.doc. Read through the Lesson Plans. Familiarize yourself with the characters listed in the Directions.
2. Go to http://kamoo.dragonangel.net and log in with the ID of Aeneas and the password student. The screen should then open to a location titled "The *Aeneid*". Watch the movie. Then print out the KaMOO Comands.doc in the Start_Here folder. Try out these commands in the KaMOO world. If you move anything, be sure you put it back, because the game is set up for play. Moving items before play begins will alter the game pattern. When students are ready to begin the game, (after reading Chapters 8-9 and completing #5) print copies for students and review together, demonstrating how the commands are used in the game.
3. Show students this QuickTime movie in the Rome KaMOO if a large screen projection is available. Explain that the students are about to embark on an adventure to discover the ancient ancestors of Rome.
4. After students view the QuickTime at http://kamoo.dragonangel.net, open the MedMap.doc, and project it on a large screen. If a large screen is not available, print out copies of the map to distribute to students. Have students locate Troy on the map. Ask what famous battle took place at Troy. Students may volunteer information about Odysseus and the Trojan Horse.
5. Allow students to discuss their background knowledge about Odysseus, and then have them locate Rome. Explain that, even though the Greeks defeated the Trojans, some of the Trojans escaped and tried to sail to Rome. One of the men who escaped was Aeneas, son-in-law of Priam, the King of Troy. The goddess Juno didn't like the Trojans, so she tried to blow them off course. Instead of landing in what we now call Italy, the Trojans landed in Carthage. Have students locate Carthage on the map. The Trojans are destined, however, to settle in Rome, so after their stay in Carthage they set sail once again for Rome. On their way, they stop off in Sicily. Have students locate this island. Finally, the Trojans land in Italy, which, in those days was called Latium because the king of the area was known as the King of the Latins.
6. Ask if students know where or when this story about these Trojans was first written down. Explain that it was written by a poet named Virgil who lived in about 100 BC. The events he wrote about supposedly happened about 3,200 years ago. Draw a timeline on the board and have students figure out what the

BC date was for 3,200 years ago. Explain that the story Virgil wrote was called the *Aeneid*. Explain that they will be reading an abridged, or shortened version of this book. After reading the story, they will then become one of the characters in the *Aeneid* and play a simulation game based on the story.

7. Explain that, the better the students know the geography of the area where they will be traveling, the better they will do in the simulation game. Allow the students the choice of either working alone or with a partner to complete the Mediterranean Map Worksheet and Map. When finished, correct the map with the students and have them turn in it in for credit if you wish to give students a grade or credit for completing it.
8. Provide students with copies of the Directions. Do not hand out the "Passports" page until students are ready to play the virtual world game. Read the directions together as a class. Let students know that later they will have a test on the gods and goddesses information included in these directions. Provide them with a link to the online Gods and Goddesses Jeopardy PowerPoint game (http://kamoo.dragonangel.net/~marie/kamoowbpg/Gods_GoddessJepdy.ppt) so they can play as a review. Let them know you will play it together as a class before taking the gods and goddesses test.
9. Provide students with copies of the Chart Worksheet (http://kamoo.dragonangel.net/~marie/kamoowbpg/ChartWksht.doc) and Flow Chart Blanks (http://kamoo.dragonangel.net/~marie/kamoowbpg/FlowChartBlanks.doc). Have them work either individually or with a partner on the worksheet. Display a colored copy (http://kamoo.dragonangel.net/~marie/kamoowbpg/FlowChartColor.doc) of the chart on a video projector, or have them view it online at http://kamoo.dragonangel.net/~marie/kamoowbpg/FlowColorChart.doc. When students finish the worksheet and complete the blanks on their chart on the backside of the worksheet, and color the boxes on the filled-in chart, have them correct their own and discuss as a class. Students can be asked to turn in the worksheets for credit. Return sheets to students to keep in their *Aeneid* folder for future reference.
10. As a class, have students play the Gods_GoddessJepdy.ppt game.
11. Have students take the Gods and Goddesses Test.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Gods and GdssTest.doc). Also see the AnsKey.doc located at http://kamoo.dragonangel.net/~marie/kamoowbpg/Gods and GoddessesAnsKey.doc.
12. As part of the preparation for the *Aeneid*, or for students wishing a challenge and/or extra credit, have students read an online abridged version of the *Odyssey*, starting with Chapter 1 at http://www.mythweb.com/ odyssey/book01.html, and progressing through Chapter 24. Those wishing to obtain extra credit could then complete the OdysseyRevQuest and Internet Hunt worksheet located at http://kamoo.dragonangel.net/~marie/kamoowbpg/OdysseyRevQuest.doc. Also see the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/AnsKeyOdysseyRevQuest.doc.

Chapter 1

1. Have students read Chapter1 of the abridged version of the *Aeneid*, either from a printed booklet, projection screen or online at http://www.kamoo. dragonangel. net/~marie/kamoowbpg/aeneas1.htm. Have students read it at home for homework, individually in class, or as a whole group from a projection screen. Both a booklet layout and an html format are on the accompanying CD.
2. Have students work in small groups to complete the Chapter 1 Review Questions (http://www.kamoo.dragonangel.net/~marie/kamoowbpg/ Chap1RevQuest.doc). Walk around and facilitate groups as needed. Review answers as a class, and have them turn in their answers for credit. See the Answer Key at http://kamoo.dragonangel.net/~marie/kamoowbpg/ Chap1RevAns Key.doc.
3. Using their answers to Part Two, discuss what the tension between "fate vs. choice" means. Have students think of modern-day examples that illustrate this tension. Working in pairs, have students create a paragraph to insert into a PowerPoint to explain and illustrate this tension, including at least three pictures downloaded from the Internet. Have students present their PowerPoint presentations to the class.
4. Provide students with copies of the handout, 1_9VocaStudy, located at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap1RevAnsKey.doc. Students should study Chapter 1 vocabulary words on their own and as a class by going to http://www.quia.com/cz/12774.html. Provide class time for students to study the vocabulary worlds alone and/or with a partner. Do this for each new chapter.
5. As a whole class (and/or working individually on home or school computers) have students practice the online quiz for Chapter 1 at http://www.cooperis. com/quizzes/other/020614mediterr.htm.
6. Provide students with copies of the Word Search (http://kamoo.dragonangel. net/~marie/kamoowbpg/1WordSearch.doc) for Chapter 1 vocabulary words. Have students turn it in for credit. You could also have students write a paragraph on a topic of your choice, challenging them to use as many vocabulary words from Chapter 1 as possible.
7. When students finish reading Chapter 1, have them take the Chapter 1 Vocabulary Quiz at http://kamoo.dragonangel.net/~marie/kamoowbpg/ 1WordSearch.doc. Also see the answer key at http://kamoo.dragonangel.net/ ~marie/kamoowbpg/Chap1QuizAnswerKey.doc.

Chapter 2

1. Students read Chapter 2. Provide students with the Chp2RevQuest.doc located at http://kamoo.dragonangel.net/~marie/kamoowbpg/ Chp2RevQuest.doc. See the answer key at http://kamoo.dragonangel.net/ ~marie/kamoowbpg/Chap2RevQuestAnsKey.doc. Also have students read

the background information located at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chp2 Roman History.doc.

2. Discuss the enduring understandings of “culture is history in the present” and how this applies to Rome’s legend of Romulus and Remus, and the later story of the *Aeneid*. Discuss how this contrasts with the Judeo-Christian culture as illustrated in the story of Cain and Abel. Compare and contrast these stories with the ideas of “might makes right” vs. “right makes might”.
3. Assign half of the class to write a three-paragraph essay comparing and contrasting the story of Romulus and Remus with the story of Cain and Abel. Have the other half write a three-paragraph response to literature essay about how the story of Aeneas might have made the Roman citizens more willing to give up their republican form of government in favor of emperors such as Julius Caesar and Augustus. Have students pair up and develop a PowerPoint presentation of their essay ideas, including at least one slide and visual for each main point in their essays.
4. Students should practice their vocabulary words on their 1_9VocaStudy sheet. They should also practice the vocabulary words online at http://www.quia.com/cm/77893.html and http://www.quia.com/jg/628664.html.
5. Students take Chapter 2 Vocabulary Quiz located at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap2Quiz.doc. Also see the answer key located at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap2QuizAnswerKey. doc.

Chapters 3-4

1. Students read Chapter 3 and then complete the Chap3RevQuest.doc at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap3RevQuest.doc. Also see the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap3RevQuestANSKeydoc.
2. Students read Chapter 4.
3. As a whole-class and/or individually, have students study vocabulary words for Chapter 3 at http://www.quia.com/cz/55977.html during class.
4. As a whole-class or individually, students can review Chapter 4 with a Hangman game at http://www.quia.com/hm/195290.html.
5. As a whole-class or individually, students can review Chapters 3-4 vocabulary by going to a Flash Card, Concentration and Word Search game at http://www.quia.com/jg/628972.html.
6. To test vocabulary words for Chapters 3-4, have students take the Chap3_4Quiz.doc at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap3_4Quiz.doc . Also see the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap3_4QuizAnsKey.doc.
7. List the characters’ names on long paper (or on the board) and post it in the front for all to see (the file “Name Plates” in the Lesson Plans folder can be used for this). Make one long list of names on the left. Have students pair up or work alone so that there are a total of 18, since there are 18 characters that must be covered in the online virtual world game, Rome KaMOO. Have the

individual students or the pair write the top three characters they would like to role-play. Have them write this on a piece of paper, numbered as their 1st, 2nd and 3rd choice. Put these papers in a basket. There should only be 18 pieces of paper, each with 3 characters' names on it from the story. Draw papers out, one at a time. List the names of the students next to their first choice character on the board. Once a character has been taken, the next student(s) choosing that character will then get their 2nd choice, and so on, until all characters are covered, and every student has a character (or pair of students). As the class continues to read the *Aeneid*, have them role-play their parts while reading. For example, use props such as shields, helmets, robes, etc. Have the student role-playing Aeneas read dialog when Aeneas speaks, etc.

8. Have students take the open notes/open book Review Quiz (see Tests/Quizzes folder, Chap1_4 QuizReview.doc at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap1_4 QuizReview.doc and the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap1_4 QuizRevAnsKey.doc

Chapter 5

1. Students read Chapter 5.
2. Provide students with *Aeneid* Chapter 5 Vocabulary Words Crossword Puzzle at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap5 Crossword Puzzle.doc. Allow students to work alone or in small groups.
3. As a whole-class, or in small groups, or individually, have students play Concentration, Flash Cards and Matching games at http://www.quia.com/jg/632805.html
4. Students take the vocabulary test: Chap5Quiz.doc at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap5Quiz.doc. Also see the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap5QuizAnsKey.doc.
5. Hand out the AeneidTmlineWksht.doc located at http://kamoo.dragonangel.net/~marie/kamoowbpg/AeneidTmlineWksht.doc. Present the Aeneid Timeline.ppt slideshow (http://kamoo.dragonangel.net/~marie/kamoowbpg/AeneidTimeline.ppt) and have students complete the student worksheet as they view the PowerPoint presentation.
6. Have students write a paragraph that addresses one of the three choices presented on slide 6 of the AeneidTimeline.ppt. Then have students who wrote on the same subject work in groups of 2-3 to create a short skit about their paragraph to present to the class.
7. Discuss the ideas of "art reflects life" vs. "art influences life." The *Aeneid* is a good example of how a political leader tried to get art to influence life. Students can also discuss potential similarities between the *Aeneid* and Brown's *The Da Vinci Code*. (Some Christians doubted their faith when Brown's book first came out because they did not know that the alleged "facts" in Brown's book were falsehoods made up by Brown.) This also provides a good springboard for discussions of the concept, "History is culture in the present." For additional "Thunder Butte' by Virginia Driving Hawk

Sneve, p. 194, Prentice Hall Literature, Timeless Voices, Timeless Themes, California Edition, Copper Level, 2002. This short story shows a clash of cultures in an American Indian family.

8. Print out “Family Album A” (http://kamoo.dragonangel.net/~marie/kamoowbpg/FamilyAlbumA.doc) and “Family Album B” (http://kamoo.dragonangel.net/~marie/FamilyAlbumB.doc) to show to students after reading the Teacher Directions.doc.
9. Review instructions with students on the Chapter 5 Review Handout (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap5RevHandout.doc). Have students work alone or with others to complete their illustrations and turn in for a grade. If students work in small groups, each student must still complete his or her own paper to turn in for a grade.

Chapter 6

1. Students read Chapter 6.
2. Working in small groups, students complete Chap6RevQuest.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap6RevQuest.doc) and Chap6 ReviewPart2.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap6 RevPart2.doc). Facilitate groups as needed. When finished, correct and discuss as a class.
3. Read the information on the “*Aeneid* Themes” worksheet (http://kamoo.dragonangel.net/~marie/kamoowbpg/AeneidThemes.doc). Then have students complete the “*Aeneid* Themes” illustrations and turn in for a grade.

Chapters 7

1. Students read Chapter 7.
2. Provide students time to review vocabulary words for chapters 6-9 at http://www.quia.com/cm/77936.html working as a whole class with the site on a video screen, or on computers, working in pairs or individually. Also refer students to the 1_9VocabStudy.doc.

Chapters 8-9

1. Students read Chapter 8 and Chapter 9. Using props, have students act out the final battle between Turnus and Aeneas as the story is read. Have students who will role-play a Trojan character sit on Aeneas’ side. Have the other students who will support Turnus sit on Turnus’ side.
2. Have students study the vocabulary words for chapters 6-9 from the 1_9VocabStudy.doc.
3. Have students review Chapters 6-9 with a Matching Game at http://www.quia.com/cm/77936.html.
4. Students can also play Concentration, Flashcards and Word Search games at http://www.quia.com/jg/359718.html for Chapters 6-9.
5. Have students prepare for, then take the VocabFinal.doc at http://kamoo.dragonangel.net/~marie/kamoowbpg/VocabFinal.doc. Also see the answer

key at http://kamoo.dragonangel.net/~marie/kamoowbpg/VocabFinalAns Key.doc.

Rome KaMOO Virtual World

1. When students finish reading the *Aeneid*, review together the Student Directions at http://kamoo.dragonangel.net/~marie/kamoowbpg/Student Directions.doc. Students were assigned their *Aeneid* characters earlier in the game. Now have them complete their Passports (http://kamoo.dragonangel. net/~marie/kamoowbpg/Passport.doc). Collect the Passports. Have these available during the gameplay. Students cannot change their coin goals after they begin play, but they can check their goals in case they forget what they wrote.
2. Provide 3-4 computer lab days for students to work through the *Aeneid* Rome KaMOO virtual world. Be sure to have the Passports available.
3. Students who violate *Aeneid* Rome KaMOO rules work independently on an assignment from the RomeProject (http://kamoo.dragonangel.net/~marie/ kamoowbpg/RomeProject/RomeProject.doc) while the rest of the class completes the Rome KaMOO online.
4. When 1-3 students (or pairs) think they have reached their goal as stated in their Passports, have them send a Moo Mail to Jupiter (the teacher). At the end of the class, check to see if the groups have taken coins from different locations. The game clearly states that students can not take more than one coin from any location. If they have violated this rule, send them back a message and explain that they can't win until they put extra coins back where they belong, and get coins from different locations. When 1-3 groups have actually won, end the *Aeneid* Rome KaMOO play and offer small prizes for 1st, 2nd and 3rd place winners to celebrate.

Final Assessments

1. Have students review for the final by playing AeneidJepdy.ppt game (http://kamoo.dragonangel.net/~marie/kamoowbpg/AeneidJepdy.ppt). Then have students take the Aeneid Final.doc (http://kamoo.dragonangel.net/ ~marie/kamoowbpg/Aeneid Final.doc). Also see the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Aeneid FinalAnsKey.doc.
2. Have students also complete the Final Essay Exam, located at http://kamoo. dragonangel.net/~marie/kamoowbpg/FinalEssayExam.doc.

APPENDIX E: LESSON PLANS USED FOR CLASS C

Lesson Plans – Traditional Instructional Strategies

Aeneid Introduction

1. Familiarize yourself with the Teacher Tips and Directions (http://kamoo. dragonangel.net/~marie/kamoowbpg/Directions.doc). Read through the Lesson Plans (http://kamoo.dragonangel.net/~marie/kamoowbpg/Aeneid Lesson Plans.doc). Review the Char Pics (http://kamoo.dragonangel. net/~marie/kamoowbpg/Char Pics in the Aeneid.doc) to familiarize yourself with the characters in the *Aeneid.*
2. Go to http://kamoo.dragonangel.net and log in with the ID of Aeneas and the password student. The screen should then open to a location titled "The *Aeneid*". Watch the movie. Then print out the KaMOO Comands.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/KaMOO Commands.doc). Try out these commands in the KaMOO world. If you move anything, be sure you put it back, because the game is set up for play. Moving items before play begins will alter the game pattern. When students are ready to begin the game, (after all assessments, including the *Aeneid* Final and Final Essay Exam) print copies of the KaMOO Commands for students and review these commands together, demonstrating how the commands are used in the game.
3. Show students this QuickTime movie in the Rome KaMOO at http://kamoo.dragonangel.net if a large screen projection is available. Explain that the students are about to embark on an adventure to discover the ancient ancestors of Rome.
4. Open the MedMap.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/ MedMap.doc) and project it on a large screen. If a large screen is not available, print out copies of the map to distribute to students. Have students locate Troy on the map. Ask what famous battle took place at Troy. Students may volunteer information about Odysseus and the Trojan Horse.
5. Allow students to discuss their background knowledge about Odysseus, and then have them locate Rome. Explain that, even though the Greeks defeated the Trojans, some of the Trojans escaped and tried to sail to Rome. One of the men who escaped was Aeneas, son-in-law of Priam, the King of Troy. The goddess Juno didn't like the Trojans, so she tried to blow them off course. Instead of landing in what we now call Italy, the Trojans landed in Carthage. Have students locate Carthage on the map. The Trojans are destined, however, to settle in Rome, so after their stay in Carthage they set sail once again for Rome. On their way, they stop off in Sicily. Have students locate this island. Finally, the Trojans land in Italy, which, in those days was called Latium because the king of the area was known as the King of the Latins.
6. Ask if students know where or when this story about these Trojans was first written down. Explain that it was written by a poet named Virgil who lived in

about 100 BC. The events he wrote about supposedly happened about 3,200 years ago. Draw a timeline on the board and have students figure out what the BC date was for 3,200 years ago. Explain that the story Virgil wrote was called the *Aeneid*. Explain that they will be reading an abridged, or shortened version of this book.

7. Explain that, the better the students know the geography of the area, the better they will understand the story. Have students work alone to complete the Mediterranean Map Worksheet (http://kamoo.dragonangel.net/~marie/kamoowbpg/MedMapWksht.doc) and Map (http://kamoo.dragonangel.net/~marie/kamoowbpg/MedMap.doc). When finished, correct the map with the students and have them turn in it in for credit if you wish to give students a grade or credit for completing it.
8. Provide students with copies of the Directions (http://kamoo.dragonangel.net/~marie/kamoowbpg/Directions.doc). Do not give students copies of the Passports at this time. Save these until they begin gameplay in the virtual world. Read through the character descriptions with students, especially noting information regarding the gods and goddesses. Let students know they will have a test later on the gods and goddesses information. To help them prepare for the test, give students the online link to the gods and goddess PowerPoint review game (http://kamoo.dragonangel.net/~marie/kamoowbpg/Gods_GoddessJepdy.ppt) for them to review on their own.
9. Provide students with copies of the Chart Worksheet (http://kamoo.dragonangel.net/~marie/kamoowbpg/ChartWksht.doc) and Flow Chart Blanks (http://kamoo.dragonangel.net/~marie/kamoowbpg/FlowChartBlanks.doc). Have them work individually on the worksheet. Display a colored copy of the chart (http://kamoo.dragonangel.net/~marie/kamoowbpg/FlowChart Color.doc) on a video projector, or have them download it from online. When students finish the worksheet and complete the blanks on their chart on the backside of the worksheet, and color the boxes on the filled-in chart, have them correct their own and discuss as a class. Students can be asked to turn in the worksheets for credit. Return sheets to students to keep in their *Aeneid* folder for future reference.
10. Provide students with time to review their notes on the gods and goddesses in order to prepare for the test.
11. Have students take the Gods and Goddesses Test.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Gods and GdssTest.doc). Also see the AnsKey.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/ Gods and GoddessesAnsKey.doc). As part of the preparation for the *Aeneid*, or for students wishing a challenge and/or extra credit, have students read an online abridged version of the *Odyssey*, starting with Chapter 1 at http://www.mythweb.com/odyssey/book01.html, and progressing through Chapter 24. Those wishing to obtain extra credit could then complete the Odyssey Review Questions and Internet Hunt worksheet (http://kamoo.dragonangel.net/~marie/kamoowbpg/OdysseyRevQuest.doc). Also see the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/AnsKeyOdysseyRevQuest.doc.

Chapter 1

1. Have students read Chapter 1 of the abridged version of the Aeneid, either from a printed booklet, projection screen or online at http://kamoo.dragonangel.net/~marie/kamoowbpg/aeneas1.htm. Have students read it at home for homework, individually in class, or as a whole group from a projection screen. Both a booklet layout and an html format are on the accompanying CD.
2. Have students individually complete the Chapter 1 Review Questions at http://www.kamoo.dragonangel.net/~marie/kamoowbpg/Chap1RevQuest.doc. Review answers as a class, and have them turn in their answers for credit. See the Answer Key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap1RevAnsKey.doc.
3. Using their answers to Part Two, discuss what the tension between “fate vs. choice” means. Have students think of modern-day examples that illustrate this tension. Have students write a paragraph explaining this tension, including examples from the story, and turn in the paragraph for a grade.
4. Provide students with copies of the handout, 1_9VocaStudy at http://www.kamoo.dragonangel.net/~marie/kamoowbpg/1_9VocabStudy.doc. On their own, students can also study Chapter 1 vocabulary words at http://www.quia.com/cz/12774.html. Encourage students to make flash cards during class time, writing the vocabulary words on the front and definitions on the back of 3x5 cards. If possible, purchase ring clasps so students can punch holes in their cards, placing them in the ring and adding more cards to the ring as they study each chapter. Provide some time for students to study during class. At home or when school computers are available during non-class time, students can practice the online quiz for Chapter 1 at http://www.cooperis.com/quizzes/other/020614mediterr.htm.
5. Haven students individually complete the Word Search at http://kamoo.dragonangel.net/~marie/kamoowbpg/1WordSearch.doc for Chapter 1 vocabulary words. Have students turn it in for credit. You could also have students write a paragraph on a topic of your choice, challenging them to use as many vocabulary words from Chapter 1 as possible.
6. When students finish reading Chapter 1, have them take the Chapter 1 Vocabulary Quiz (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap1Quiz.doc). Also see the answer key at http://kamoo.dragonangel.net/~marie/ kamoowbpg/Chap1QuizAnswerKey.doc.

Chapter 2

1. Students read Chapter 2. Provide students with the Chp2RevQuest.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chp2RevQuest.doc). See the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap2RevQuestAnsKey.doc. Also print out for students and have them read the Chp2 Roman History.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chp2RomanHistory.doc).

2. Assign half of the class to write a three-paragraph essay comparing and contrasting the story of Romulus and Remus with the story of Cain and Abel. Have the other half write a three-paragraph response to literature essay about how the story of Aeneas might have made the Roman citizens more willing to give up their republican form of government in favor of emperors such as Julius Caesar and Augustus. Have students share these essays in class.
3. Students should practice their vocabulary words on their 1_9VocaStudy sheet. They can also practice the vocabulary words online at http://www.quia.com/cm/77893.html and http://www.quia.com/jg/628664.html.
4. Students take Chapter 2 Vocabulary Quiz (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap2Quiz.doc). See the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap2QuizAnswerKey.doc.

Chapters 3-4

1. Students read Chapter 3 and then complete the Chap3RevQuest.doc at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap3RevQuest.doc. Also see the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap3RevQuestANSKeydoc.
2. Students read Chapter 4.
3. Students can study vocabulary words for Chapter 3 at http://www.quia.com/cz/55977.html
4. Provide class time for students to individually study vocabulary for chapters 3-4.
5. To test vocabulary words for Chapters 3-4, have students take the Chap3_4Quiz.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap3_4Quiz.doc). Also see the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap3_4QuizAnsKey.doc.
6. Provide students with copies of the Directions handout (http://kamoo.dragonangel.net/~marie/Directions.doc). Do not hand out the “Passports” page until students are ready to play the virtual world game. Read the directions together as a class. Explain that, even though you will not play the virtual online game until after the final test and final essay, students (or pairs of students) will now choose a character from the *Aeneid* that they will role-play in the game, and will role-play as you read the rest of the story.
7. List the characters’ names on long paper (or on the board)and post it in the front for all to see (the file “Name Plates” in the Lesson Plans folder can be used for this). Make one long list of names on the left. Have students pair up or work alone so that there are a total of 18, since there are 18 characters that must be covered in the online virtual world game, Rome KaMOO. Have the individual students or the pair write the top three characters they would like to role-play. Have them write this on a piece of paper, numbered as their 1st, 2nd and 3rd choice. Put these papers in a basket. There should only be 18 pieces of paper, each with 3 characters’ names on it from the story. Draw papers out, one at a time. List the names of the students next to their first choice

character on the board. Once a character has been taken, the next student(s) choosing that character will then get their 2nd choice, and so on, until all characters are covered, and every student has a character (or pair of students). As the class continues to read the *Aeneid*, have them role-play their parts while reading. For example, use props such as shields, helmets, robes, etc. Have the student role-playing Aeneas read dialog when Aeneas speaks, etc.

8. Have students take the open notes/open book Review Quiz (see Tests/Quizzes folder, Chap1_4 QuizReview.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap1_4 QuizReview.doc). See the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap1_4QuizRev AnsKey.doc.

Chapter 5

1. Students read Chapter 5.
2. Provide students with *Aeneid* Chapter 5 Vocabulary Words Crossword Puzzle at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap5 Crossword Puzzle.doc.
3. Provide class time for students to study vocabulary words for chapter 5.
4. Students take the Chap5Quiz.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap5Quiz.doc) for the Chapter 5 vocabulary words. See the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap5QuizAnsKey.doc.
5. Hand out the AeneidTmlineWksht.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/AeneidTmlineWksht.doc). Present the AeneidTimeline.ppt slideshow (http://kamoo.dragonangel.net/~marie/kamoowbpg/AeneidTimeline.ppt) and have students complete the student worksheet as they view the PowerPoint presentation.
6. Have students write a paragraph that addresses one of the three choices presented on slide 6 of the AeneidTimeline.ppt.
7. Discuss the ideas of "art reflects life" vs. "art influences life." The *Aeneid* is a good example of how a political leader tried to get art to influence life. Students can also discuss potential similarities between the *Aeneid* and Brown's The Da Vinci Code. (Some Christians doubted their faith when Brown's book first came out because they did not know that the alleged "facts" in Brown's book were falsehoods made up by Brown.) This also provides a good springboard for discussions of the concept, "History is culture in the present." For additional "Thunder Butte' by Virginia Driving Hawk Sneve, p. 194, Prentice Hall Literature, <u>Timeless Voices, Timeless Themes</u>, California Edition, Copper Level, 2002. This short story shows a clash of cultures in an American Indian family.
8. Print out "Family Album A" (http://kamoo.dragonangel.net/~marie/kamoowbpg/FamilyAlbumA.doc) and "Family Album B" (http://kamoo.dragonangel.net/~marie/FamilyAlbumB.doc) to show to students after reading the Teacher Directions.doc (kamoo.dragonangel.net/~marie/kamoowbpg/Teacher Directions.doc).

9. Review instructions with students on the Chapter 5 Review Handout (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap5RevHandout.doc). Have students work individually to complete their illustrations and turn in for a grade.

Chapter 6

1. Students read Chapter 6.
2. Working individually, have students complete Chap6RevQuest.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Chap6RevQuest.doc) and Chap6 ReviewPart2.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/ Chap6 RevPart2.doc). This is not a test. Help students individually as needed. When finished, correct and discuss as a class.
3. Read the information on the "*Aeneid* Themes" worksheet (http://kamoo. dragonangel.net/~marie/kamoowbpg/AeneidThemes.doc) with the class. Then have students individually complete the "*Aeneid* Themes" illustrations and turn in for a grade.

Chapters 7

1. Students read Chapter 7.
2. Provide class time for students to individually review vocabulary words for chapters 6-9 (see the 1_9VocabStudy.doc. located at http://kamoo. dragonangel.net/~marie/kamoowbpg/1_9VocabStudy.doc). Also provide students with the link at http://www.quia.com/cm/77936.html to review vocabulary words online while at home or during non-class time on school computers.

Chapters 8-9

1. Students read Chapters 8-9. Using props, have students act out the final battle between Turnus and Aeneas as the story is read. Have students who will role-play a Trojan character sit on Aeneas' side. Have the other students who will support Turnus sit on Turnus' side.
2. Provide time for students to individually study vocabulary words for Chapters 8 and 9 in class.
3. Have students study the vocabulary words for chapters 6-9 from the 1_9VocabStudy.doc.
4. Have students prepare for the vocabulary final. See the *Aeneid* Final.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Aeneid Final.doc) and AeneidFinalAnsKey.doc at http://kamoo.dragonangel.net/~marie/ kamoowbpg/AeneidFinalAnsKey.doc.

Assessments

1. Have students take the vocabulary final. See the VocabFinal.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/VocabFinal.doc). Also see the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/ VocabFinalAnsKey.doc.

2. Have students take the *Aeneid* final. See the *Aeneid* Final.doc (http://kamoo.dragonangel.net/~marie/kamoowbpg/Aeneid Final.doc). See the answer key at http://kamoo.dragonangel.net/~marie/kamoowbpg/AeneidFinalAnsKey.doc.
3. Have students also complete the Final Essay Exam (http://kamoo.dragonangel.net/~marie/kamoowbpg/FinalEssayExam.doc) .

Rome KaMOO Virtual World

1. When students finish reading the *Aeneid* and all final exams, review together the Directions (http://kamoo.dragonangel.net/~marie/kamoowbpage/Directions.doc). Students were assigned their *Aeneid* characters earlier in the game, and must now complete their Passports (http://kamoo.dragonangel.net/~marie/kamoowbpg/Passport.doc). Collect the Passports. Have these available during the gameplay. Students cannot change their coin goals after they begin play, but they can check their goals in case they forget what they wrote. Be sure students also have the KaMOO Commands (http://kamoo.dragonangel.net/~marie/kamoowbpg/KaMOO Commands.doc).
2. Provide 3-4 computer lab days for students to work through the *Aeneid* Rome KaMOO virtual world. Be sure to have the Passports available.
3. Students who violate *Aeneid* Rome KaMOO rules work independently on an assignment from the RomeProject (http://kamoo.dragonangel.net/~marie/kamoowbpg/ RomeProject/RomeProject.doc) while the rest of the class completes the Rome KaMOO online.
4. When 1-3 students (or pairs) think they have reached their goal as stated in their Passports, have them send a Moo Mail to Jupiter (the teacher). At the end of the class, check to see if the groups have taken coins from different locations. The game clearly states that students can not take more than one coin from any location. If they have violated this rule, send them back a message and explain that they can't win until they put extra coins back where they belong, and get coins from different locations. When 1-3 groups have actually won, end the *Aeneid* Rome KaMOO play and offer small prizes for 1st, 2nd and 3rd place winners to celebrate.

APPENDIX F: EXPERTISE STRUCTURES

EXPERTISE STRUCTURES	Novice – Level 1	Intermediate – Level 2	Advanced – Level 3
Knowledge Structures	Deductive; gains knowledge structures through concrete information and surface features.	Inductive; begins to organize knowledge into more accessible structures (mental representations of knowledge). Moves from searching for information to searching for rules, or principles.	Acquisition; faces problems that challenge current knowledge and competency and reorganizes existing knowledge to connect with new concepts.
Cognitive Functions (Problem-solving Strategies)	Anticipates results through the use of trial and error and best guess methods. Uses observation and problem reduction rather than underlying principles.	Has a minimal understanding of underlying principles and uses these to formulate problem-solving strategies.	A thorough understanding of underlying principles provides a working hypothesis to solve the problem. Relies on a systematic representation of domain-specific knowledge.
Mental Representations (Automaticity)	Lacks awareness of underlying principles; cannot generate mental representations of the problem.	Has a basic understanding of underlying principles that provide an internal structure of knowledge, and a basic visual representation and or pattern recognition ability. Has a limited ability to use these representations as cognitive tools.	Generates complex representations about problems, which provide images to support constant reflections on and improvements in decision-making and actions.

APPENDIX G. CATEGORY DATABASE OF EXPERTISE LEVELS

Participants' video transcripts, illustrations and textual descriptions of their mental models will be coded, segmented and categorized to create a database illustrating participants' levels of expertise. The database coding will distinguish between participants in the first and second groups.

LEVELS OF EXPERTISE	KS1	CF1	MR1	KS2	CF2	MR2	KS3	CF3	MR3
CODED SEGMENTS									
Video transcript Segments									
Illustrations of mental models									
Textual descriptions of mental models									

APPENDIX H. CATEGORY DATABASE OF SCCS USE

Participants' video transcripts, illustrations, and textual descriptions of their mental models will be coded, segmented and categorized to illustrate participants' use of their social and cognitive-connectedness schemata.

USE OF SCCS	Link	Lurk	Lunge	Navigation Literacy	Discovery-Based Learning	Reasoned Judgment
CODED SEGMENTS OF SCCS USE						
Video transcript segments						
Illustrations of mental models						
Textual descriptions of mental models						

APPENDIX I. TRANSFER MEASUREMENTS

Demonstrate your understanding of the four themes discussed in the *Aeneid*, and illustrate this understanding by providing examples of these themes from the *Aeneid*, as well as from everyday life. Answers will be assessed using the following rubric.

Assessment Rubric

1. Few facts are identified, described or defined. The response insufficiently addresses the concept. Logic is flawed, and/or digresses significantly.
2. Some facts are identified, described or defined. The response somewhat addresses the concept. Logic is a little flawed, and/or digresses somewhat.
3. Several facts are accurately identified, described or defined. The response is logical, addresses, explains and/or defines the concept, and relates it to the facts presented.
4. Facts are accurately and clearly identified, described or defined. The response is logical and includes a judgment of the concept's value based on personal opinions. The response also compares, contrasts, interprets, criticizes, defends or justifies the information presented.

Criteria	1	2	3	4	TOTALS
Part A					
Part B					
			TOTAL SCORE		

Theme Questions

Directions: Write at least two paragraphs for each of the themes listed below (for a total of eight paragraphs). In your first paragraph (A), support your understanding of the theme with specific examples from the *Aeneid*. In your second paragraph (B), provide examples of the theme using modern-day situations.

1. Culture is history in the present
2. Fate vs. personal choice
3. Might makes right vs. right makes might
4. Art reflects culture vs. art influences culture

1. *Culture is history in the present*

   Part A: In a short paragraph, explain what you think "culture is history in the present" means. Provide examples from the *Aeneid* to illustrate your understanding of this phrase.

   Part B: In a short paragraph, provide a modern-day example of how culture is history in the present that is not from the *Aeneid*.

2. *Fate vs. personal choice*

   Part A: In a short paragraph, explain the difference between fate and personal choice. Give examples from the *Aeneid* that illustrate the tension of fate vs. personal choice.

   Part B: In a short paragraph, give a more current example of fate vs. choice that is not from the *Aeneid*.

3. *Might makes right vs. right makes might*

   Part A: Did Virgil write the *Aeneid* more to illustrate the idea of "might makes right", or the idea that "right makes might"? In a short paragraph, illustrate your understanding of the difference between these phrases**,** supporting your opinion with examples from the story.

   Part B: Give another example, not from the *Aeneid*, that further illustrates your understanding of might makes right or might makes right.

4. *Art reflects culture vs. art influences culture*

   Part A: Is the *Aeneid* an example of art reflecting culture, an example of art influencing culture, or an example of both? Write a short paragraph to explain your opinion, supporting it with examples from the *Aeneid*.

   Part B: Write a short paragraph that gives examples, not from the *Aeneid*, to support just **one** of the ideas below:

   a. art reflects culture
   b. art influences culture
   c. art both reflects and influences culture

APPENDIX J. DATABASE CODE DEFINITIONS

General Database Codes

Code	Code Definition
L#	Coded segment line number
000000	Student ID number
040207	Month, day and year data was recorded
TR	Transcript of conversation observed during class
V#	Video clip and reference number, transcribed for data input
gif#	Picture from classroom
I	Students' illustrations of mental models
TD	Textual descriptions of mental models
T	Tests
E	Essays
CA	Class A: Students taught using SCCS instructional strategies
CB	Class B: Students taught using SCCS instructional strategies
CC	Class C: Students taught using instructional strategies that do not intentionally incorporate elements of students' SCCS (Figure 2)

Database Codes for Students' Expertise Levels

Code	Code Definition
KS1	Use of knowledge structures, novice level
KS2	Use of knowledge structures, intermediate level
KS3	Use of knowledge structures, advanced level
CF1	Use of cognitive functions (problem-solving strategies) level 1
CF2	Use of cognitive functions (problem-solving strategies) level 2
CF3	Use of cognitive functions (problem-solving strategies) level 3
MR1	Mental representations (automaticity) level 1
MR2	Mental representations (automaticity) level 2
MR3	Mental representations (automaticity) level 3

Codes for Students' Social and Cognitive-Connectedness Schemata Use

SC1	Social-Connectedness Schema of Link
SC2	Social-Connectedness Schema of Lurk
SC3	Social-Connectedness Schema of Lunge
CC1	Cognitive-Connectedness Schema of Navigation Literacy
CC2	Cognitive-Connectedness Schema of Discovery-Based Learning
CC3	Cognitive-Connectedness Schema of Reasoned Judgment Based on a Plethora of Resources

APPENDIX K. EXPERTISE USE AND SCCS RELATIONSHIPS

The theory of expertise indicates that learning transfer can be evidenced by the use of advanced levels of knowledge structures, cognitive functions, and mental representations, as described in Appendix F. The database was analyzed to identify students’ use these of expertise structures, as well as instances of students’ SCCS employment. Appendix K graphically illustrates relationships between students’ use of expertise structures and their SCCS employment.

Line #	KS3	CF3	MR3	SC1	SC2	SC3	CC1	CC2	CC3	Class
L11	X			X	X	X			X	A
L45	X					X			X	B
L48			X						X	B
L74			X							C
L75			X							C
L76			X							C
L78			X							B
L79			X							B
L80			X							B
L83		X								C
L84			X							C
L85		X								C
L86		X								C
L87			X							C
L92	X	X				X	X	X		B
L93	X	X				X	X	X		B
L96	X	X				X	X	X		A
L101	X	X				X	X	X		A
L107	X	X				X				B
L117	X	X	X							B
L122	X	X	X							B
L123	X	X	X							B
L126	X									A
L127	X	X	X							A
L128	X	X	X							B
L129	X	X	X							B
L130	X	X	X							B