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Introduction

Promoting Strategic Thinking Skills in Middle-School Students Using *Set: The Family Game of Visual Perception*®

Games are a natural expression of children's playfulness and energy. Excitement, joy, and involvement motivate them to continue to play until they have mastered the game. Strategy games, in particular, address development of mental acuity and intellectual maturity essential to academic success. Consequently, educators, particularly in the primary and elementary grades, may incorporate subject-specific games into classroom practices to support cognitive and academic development. For example, math bingo, math specific board and card games, and interactive educational software may reinforce knowledge of mathematical operations (Falco, 2001). Crossword puzzles and word searches increase and strengthen vocabulary in both language arts and science. Riddles introduce metaphors, similes, analogies, and descriptive language as well as assessing reading comprehension (Zipke, 2007). However, as children enter the middle and upper grades, game usage declines as classroom teachers shift from teaching learning strategies to instructing in content (Joseph, 2006). This study asks the question: What are the effects, if any, of a curriculum using *Set: A Family Game of Visual Perception*® (Copyright ©1988, 1991 Cannei, LLC) on strategic thinking skills of middle school students?

Metacognitive Awareness and Strategic Thinking

Many of educators hold the misperception that direct instruction in teaching strategic thinking stops at the end of elementary school (Joseph, 2006). As a result, less proficient students may fall behind because they are struggling to grasp unfamiliar material without in-depth comprehension (Day, 1994; Vaidya, 1999). Teachers may rely upon a more traditional teaching model that follows the pattern of giving an assignment with the expectation that the

student will produce the work. The teacher then evaluates the product and assigns a grade. A student may rely upon rote memorization and fact regurgitation rather than developing a deeper and more substantive understanding of the subject (Day, 1994). In short, the student becomes a passive participant in her education because she does not understand how or why she learns (Joseph, 2006). Deepening her awareness of her cognitive processes and developing appropriate learning strategies may engage the student more fully and enhance her educational experience. The student builds metacognitive awareness, which according to Joseph, is "the ability to be self-reflective learners by thinking about their own thinking…they are able to reflect upon their cognitive processes" (Joseph, 34). Strategic thinking, an integral part of metacognitive awareness, allows learners to access prior knowledge, monitor comprehension, correct misconceptions, synthesize information, draw inferences, and ask questions. As a result, they begin to understand and own their cognitive processes. Strategy games, such as *Set: The Family Game of Visual Perception*® may support the production of strategic thinking skills and possibly increase metacognitive awareness. Finally, skills acquired playing *Set*® may transfer or generalize to academic endeavors in the classroom.

Background of Study

Attributes of Set®

As an educational therapist, I have observed that incorporating *Set*® into student sessions appears to have had positive effects on the students' metacognitive awareness and strategic thinking abilities. Additionally, students enjoy the challenge and playfulness of the game. *Set*® consists of eighty-one cards with four variable features:

- Symbols—One of the following: ovals, squiggles, or diamonds
- Colors—Symbols are either red, green, or purple

- Number—Each card has one, two, or three symbols
- Shading—Symbols are either solid color, striped, or outlined with one of three colors

Below are examples of the variables:

Players search for three cards that represent a set based on specific criteria. Sets may consist of similarities, differences, or a combination of both. In order to be successful, players must be aware of how they form sets and engage in strategic thinking to find them.

Purpose of the Study

Learning non-academic strategy games such as *Set: The Family Game of Visual Perception*® may more fully teach and integrate strategic thinking into a student's academic life. This study proposes to explore the relationship, if any, between increased proficiency in *Set*®, and enhancement of strategic thinking in middle school students. Models for metacognitive instruction used to teach strategic thinking share common characteristics: teacher directed instruction and modeling of strategic thinking skills, student/teacher guided practice and application, and independent student activity. For the purposes of this instruction, I used the Metacognitive Training Framework (MTF) used by Kelley and Clausen-Grace (Kelley, 2008), which incorporates teacher instruction and self-talk, teacher directed practice, and independent student practice. I selected *Set*® as it incorporates the following cognitive skills: temporal-sequential ordering, spatial ordering, memory, concept formation, creativity, reasoning or logical thinking, shifting mental representations, and critical thinking—abilities that are essential academic and life skills (Falco, 2001). Using the explicit methods of strategy games may more fully integrate these learning processes and provide a cognitive framework that transfers to other

subjects (de Bruin, 2007; Engle, 2006; Kramakski, Mevarach, & Lieberman, 2001; Rogers, 1994). Additionally, incorporating *Set*® into the classroom as a learning activity may provide a non-traditional, multidimensional approach to cognitive tasks, including memory, organization, strategy development, and abstract thinking skills. Just as simple word games, rhymes, and poems lay the foundation for learning for young children (Zipke, 2007), *Set*® might change the way in which older children achieve metacognitive awareness and strategic thinking skills.

Effective Learning Skills

In order to learn effectively and efficiently, individuals need cognitive skills anchored in metacognitive awareness and strategic thinking (Day, 1994; Joseph, 2006). In learning to play *Set*® proficiently, students engage in an analysis of how they think about set formation. They explain strategies that they use and modify them to increase success at the game. This researcher has discovered that engaging students in a discussion of how they perceive the sets enhances their enjoyment and success with the game. In order to do so, they need to think about how they think or, in other words, increase metacognitive awareness. As an educator, I have observed that as students move towards mastery, children who lack academic self-confidence begin to take pride in their abilities to excel at the game and appear to become more proficient strategic thinkers. This researcher's experiences suggest that *Set*® teaches and reinforces:

- Abstract or meta reasoning through strategy development and card sorting
- Metacognitive awareness through student evaluation of strategies
- Development and understanding of strategic thinking skills

Additionally, as players become more proficient, I have observed that students begin to process visual cues more rapidly in order to become competitive players. They may also cultivate the ability to swiftly interpret, remember, and create new information—required academic skills for

mature and independent learners. Game players also order objects into patterns and learn to recognize card sets simultaneously, attributes of mathematics, science, and reading comprehension (Kramakski, Mevarach, & Lieberman, 2001). Finally, they learn to independently organize and create their own sets, by applying specific rules. Due to the emphasis on metacognitive awareness and strategic thinking skills, it is hoped that these skills will be applied beyond *Set*® and into the classroom.

Definition of Terms

Metacognitive Awareness

Metacognitive awareness, for the purposes of this study, is defined as the ability to be a self-reflective and self-regulated learner who considers and comprehends her cognitive processes (Day, 1994). She is able to understand and use self-knowledge about cognitive strengths and weaknesses to develop additional skills and move towards intellectual maturity. She builds the ability to think about and comprehend how she approaches learning as well as the ability to plan, monitor, and evaluate her learning. These skills aid students in reading comprehension, writing, memory, problem solving, and related areas of education (Joseph, 2006).

Strategic Thinking

Strategic thinking, for the purposes of this study, is defined as a cognitive process that allows a student to access prior information, monitor comprehension, correct misunderstandings, synthesize and extrapolate information, and ask relevant clarifying questions. Strategic thinking may be taught by training students in metacognitive awareness (Day, 1994).

Limitations

The study is limited because of the small size of the sample and the difficulty in separating and measuring discrete aspects of strategic thinking instruction that cause the

anticipated learning effect. Formulating clearer educational implications is not possible at this point without an experimental design. Formal assessments of strategic thinking skills may further support the anticipated results. However, time limitations prevent this researcher from administering those assessments. Finally, post-2000 research on strategy games designed to teach strategic thinking focused primarily on computerized games. As a result, this researcher may refer to studies of strategy games and strategic thinking written prior to 2000. Despite the limitations, this study hopes to provide the foundation for future studies in using non-computerized strategy games as a means of teaching strategic thinking skills. I hope that educators may be informed about the feasibility of alternative methods of incorporating strategic training into their curricula.

Literature Review

Metacognitive Awareness, Strategic Thinking, and Knowledge Acquisition

For the past thirty years, the role of metacognitive awareness and strategic thinking in the classroom has been one of the major focuses of educational research (Beyer, 2008; Wong, 1993). According to Beyer (2008), cognition, a multifaceted and complex mental phenomenon, requires the mastery and integration of four basic thinking skills: comparing, classifying, sequencing, and predicting. Metacognitive awareness requires that students recognize and understand their cognitive processes as well as how they apply those skills. Beyer asserts that students who do not acquire these skills seldom become thoughtful and independent learners. He continues that skill subsets such as decision-making, problem solving, drawing conclusions, analyzing, and identifying cause and effect develop critical thinking skills. He states further that direct instruction in metacognitive awareness and strategic thinking increases academic proficiency. Additionally, he concludes that this instruction must include further explicit strategies for transferring the newly learned thinking skills to other domain-specific contexts (Beyer, 2008). The cognitive researchers and educators cited below have become involved in developing and introducing metacognitive curricula with the goal of integrating strategic thinking skills into classrooms.[1] The purpose of this literature review is to examine several of these approaches

Metacognitive Awareness Defined

In order to create successful learners, educators attempt to arm their students with skills necessary for critical evaluation, attainment of new knowledge, and a dedication to life-long learning. Metacognitive awareness, the ability to plan, monitor, and evaluate one's learning, aids students in reading comprehension, writing, memory, problem-solving, and related areas of

[1] Because of the number of researchers and educators cited, please consult the references at the end of the study for a comprehensive list.

education (Beyer, 2008; Day, 1994; Joseph, 2006). Students become aware of how their ability to comprehend tasks and make judgments about possible outcomes through building strategic thinking skills affects their ability to more fully understand and internalize knowledge. Joseph (2006) states that, "studies of adolescent learning behavior describe that metacognitive behavior can be taught, resulting in practical skills to use throughout their lives" (Joseph, p. 34). Joseph maintains that the failure to establish and maintain an effective focus may lead to frustration, confusion, and lack of academic self-confidence. On the other hand, metacognitive awareness and strategic thinking assist in learning how to access academic strengths and recognize weaknesses (Day, 1994; Vaidya, 1999). Combined, the students attain intellectual maturity. Joseph continues that metacogtnitively aware students learn to access prior knowledge, monitor comprehension, correct misunderstandings, synthesize information, draw inferences, ask questions, and internalize effective strategies for approaching learning (Joseph, 2006).

Metacognition and Cognition Defined

In order to grasp the relevance of teaching metacognitive awareness, both cognition and metacognition need to be differiated and defined. Sungar (2007) states that metacognition differs from cognition in that, "cognitive strategies are task-related strategies such as note-taking, summarizing, and outlining, while metacognitive strategies emphasize planning and monitoring one's learning and being aware of which strategies are suitable for use across academic tasks" (Sungur p. 316). Vaidya (1999) adds that cognitive learning tends to be specific to the learning task. As a result, some cognitive strategies may apply only to learning that particular task (Vaidya, 1999). On the other hand, metacognition helps a student to recognize her cognition and control it. She develops the ability to plan, sequence, and monitor her cognition, thereby enhancing the academic outcome (Beyer, 2008; Day, 1994; Pressley, 1990; Protheroe, 2008). In

short, the student is learning about effective and efficent learning. Unlike cognitive strategies, metacognitive strategies may be modified and transferred to other subjects or tasks (Day, 1994). While cognitive strategies represent concrete actions required for learning, metacognition delves into the more abstract and conscious control of material. Sungur (2007) asserts that metacognitive activities involve, "conscious experiences, which can be either cognitive or affective, pertinent to ongoing cognitive processes…likely to occur in situations that provide opportunities for thoughts and feEvanng about one's own thinking to arise" (Sungur, p. 316). Research has shown the introducing a metacognitive model into the classroom supports the development of metacognitive awareness and strategic thinking skills (Joseph, 2006; Kelley, 2008; McMahon, 2008; Vaidya, 1999). In order for students to build metacognitive awareness, teachers may construct an educational experience using specific metacognitive frameworks from which creative, thoughtful, engaged and strategic learners emerge.

Strategic Thinking

An intergral component of metacognitive awareness is strategic thinking—a system of a well-thought out learning approachs that permit learners to effectively move from one point to another. Strategic thinking consists of learning behaviors that direct and influence how the student processes information (Wong, 1993). Proetheroe and Clark (2008) further define learning strategies as ways in which an individual approachs a task and how that person might think and act when planning, executing, and evaluating tasks (Protheroe, 2008). Vaidya (1999) notes that, "when these strategies are integrated into content area learning, the learning outcomes are successful" (Vaidya, p. 187). She also bEvaneves that an individual's interpretation of these strategies influence future learning behavior.

According to Day and Elksmin's research (1994), low achieving students "often experience continued frustration and failure in an academic setting" (Day, 264). They found that these students frequently do not have a comprehensive system for planning, organizing, rehearsing recalling information, and monitoring their performance. In short, they lack thinking strategies that might reduce frustration and increase success. They may become passive and dependent learners, incapable of learning independently (Day, 1994; Joseph, 2006; Vaidya, 1999). Successful strategy instruction that focuses on how to learn effectively guides students towards metacognitive awareness. They also learn to modify acquired strategic thinking skills to meet the needs of any classroom (Sungur, 2007). It is essential that students grasp the concept that strategies are useful in approaching, completing, or modifying task performance. They must comprehend the rationale behind a strategy's use and become intrinsically committed to using learning strategies (Beyer, 2008; Pressley, 1990).

Metacognitive Experiences

Day and Elksmin (1994) delineate several steps required for effective strategic learning. First, the students actively analyze their cognitive strengths and weaknesses; they are encouraged to set realistic goals that enhance motivation, focus attention, and provide incentives. Next, the instructor models strategy development through self-talk as she explains her own thought process. The teacher invites the students to participate in deciding what strategies the instructor intends to try. Both students and teacher provide examples of strategies and discuss various ways in which they may be used at school, in their homes, and within the community. Once the students have determined which strategies they might use, they create memory prompts such as bulletin boards or charts and mnemonic devices. The teacher continues to monitor student efforts. Finally, they begin to explore and experiment with specific strategies based on the

content and context, discarding those that are ineffective and retaining the ones that enhance their comprehension. By engaging in a metacognitive exercise, or thinking about thinking, the students become active participants in their educations. Kelley and Clausen-Grace (2008) concur in this assessment of appropriate methodology.

Metacognitive Framework (MTF)

The Metacognitive Teaching Framework (MTF) employed by Kelley and Clausen-Grace (2008) in their 2007 action research study of metacognitive transfer mirrors several aspects of the Day and Elksmin methodology. Kelley and Clausen-Grace examine the effects of teaching middle school students to be strategic thinkers in overall reading comprehension, particularly non-fiction. Kelley and Clausen-Grace note that, "most of the texts used were related to the science and social studies concepts being taught and included relevant textbooks, trade books, and student periodicals, such as Weekly Reader" (Kelley, p. 24). Kelley introduced the MTF curriculum to Clausen-Grace's middle school language arts classroom.[2] Kelley and Clausen-Grace use the Developmental Reading Assessment (DRA) designed for grades 4-8 for both pre- and post-evaluation. Kelley states that, "this assessment tool places students at either intervention, instructional, independent, or advanced levels in the areas of engagement, fluency, and comprehension" (Kelley, p. 23). The assessment revealed that all students in the class would benefit from direct instruction in connecting, predicting, questioning, visualizing, and summarizing. As with Day's structure (1994), the teacher initially demonstrates, defines, and explains the introduced strategies. She may analyze what makes the task challenging and suggest possible strategies for attaining a particular outcome or goal. The students then begin to assist in strategy development through discussion and practice. The teacher may ask the students questions about how they arrived at a particular conclusion, offering assistance, and encouraging

[2] Kelley, et. al. did not specify the number of participants in the study, nor their specific grade level.

the students to engage in strategic thinking. Finally, as the students gain competency in assessing strategies, they perform tasks independently. They consider their thought processes and apply them to attaining their academic goals (Joseph, 2006; Kelley, 2008). Ultimately, strategic thinking will become intrinsic and transferable to other tasks (Beyer, 2008, Day, 1994; Kelley, 2008; Protheroe, 2008). [3]

Kelley and Clausen-Grace (2008) expressed concern that students may not be transferring the strategic thinking to other areas of independent reading. Therefore, specific discussions of strategy use, observations, and evidence and use of tally sheets measured acquisition and integration of strategies. In addition, the researchers designed self-assessment goal sheets for each strategy, mirroring the tally sheets used in their direct instruction. Kelley and Clausen-Grace concluded that introducing the MTF to their students enhanced their abilities to delve into any text at a deeper level. They also assert that metacognitive strategies, once they became intrinsic, will transfer to other academic tasks as the MTF promotes inquiry, provides a routine for strategic learning, and builds a metacognitive vocabulary that can be applied to all academic endeavors (Kelley, 2008). Nancy Protheroe, et al's (2008) research supports the Kelley hypotheses and she notes that strategic thinking skills acquired through metacognitive instruction may transfer to other academic and non-academic tasks (Protheroe, 2008). In short, educators can create a community of thoughtful strategic thinkers (Kelley, 2008). Further research by Kramakski, Mevarach, & Lieberman (2001) supports the importance of building cross-curricular strategies.

Active physical participation in learning may have further benefits in enhancing strategic thinking. Rogers and Aston's research (1994) explores four different learning strategies based on Craik's theory of memory and children's learning. Craik's theory contains four major

[3] A more comprehensive discussion of transfer and generalization effects begins on p. 15.

components: remembering or learning, close attention, elaborate encoding consisting of depth and spread or embedding, and fully descriptive encoding (Rogers, 1994). Rogers and Aston's study relies upon a concrete activity that involves physical interaction with a learning environment. Two hundred fifty-ten and eleven year olds participated in the study. Four heterogeneous groups were assigned to one of four instructional interventions: formal teaching based on a guided tour with no active student participation, guided discovery using teacher-generated worksheets with specific questions on salient features, free discovery with little instruction or direction, and finally, special learning games that focused the participants attention on salient information. The results indicated that formal and guided discovery worked for concrete information and recording of facts, but did not require independent thinking. The participants often missed salient points and failed to recall them after a two-week interval. Free discovery, on the other hand, supported analytical thinking and independent extrapolation of information but failed in helping participants to formulate learning strategies for information retention. Finally, those students involved in special learning games retained information and recalled relevant details more readily. The researchers concluded that unstructured learning had little benefit while a combination of formal instruction, guided inquiry, and learning games enjoyed the most positive effects. Rogers and Aston also noted that the learning games required more strategic thinking than the other three methods and had the highest rate of retention (Rogers, 1994).

Transfer and Generalization Effects

Kramakski, Mevarach, & Lieberman (2001) studied the effects of two levels of metacognitive training on mathematical reasoning. Participants from six-seventh grade classrooms were assigned to one of three groups—multilevel, unilevel, or control. Participants

in the multilevel metacognitive training group (MMT) received metacognitive instruction in both math and English classes. Those in the unilevel training group (UMT) received metacognitive instruction in just mathematics. The control group had no metacognitive training. Kramanski, et al (2001) hypothesize that providing metacognitive training in both math and English (MMT) would lead to significant gains in achievement. On the other hand, those who participated in UMT classes or had no training would have lower levels of achievement. In fact, the results of their study indicated that the MMT group not only outperformed the UMT and control groups, but were able to transfer their strategic thinking skills to foreign language acquisition, solving complex tasks, or solving more conventional problems. Additionally, the researchers discovered no significant difference between the UMT and control groups the ability to transfer strategies from one domain to another . Consequently, while some UMT participants showed improvement in mathematics, similar gains in other academic subjects did not occur. However, they suggest that future researchers might develop more appropriate domain-specific metacognitive training frameworks in order to support cross-curricular transfer.

Explicit training in metacognitive awareness and strategic thinking encourages students to become independent and self-aware learners (Beyer, 2008; Day, 1994; Joseph, 2006; Protheroe, 2008). The research cited above suggests that strategic thinking skills may be transfered or generalized from on domain to another.[4] Several of the cited researchers theorize that because direct instruction in strategic thinking focuses on understanding the cognitive process , transfer between domain specific tasks may occur (Day, 1994; de Bruin, 2007; Kramakski, Mevarach, & Lieberman, 2001). DeBruin (2007) requires that participants analyze strategic moves in a chess endgame. Participants' strategic training focuses on self-reflection

[4] The differences between the terms transfer and generalization are minimal; therefore, they are frequently used interchangeably in the cited references.

and self-regulation as well as prediction and judgement. De Bruin (2007) believes that these insights into cognitive processing might transfer to educational settings and improve academic outcomes. Day agrees that, "strategy instruction in specific academic areas has not only increased student performance, but has also fostered greater involvement in learning, yielded higher frequency of strategy use, and created greater awareness of strategic approaches" (Day, p. 267). He further asserts that strategic instruction aids students in developing transferrable metacognitive techniques that may be modified and adapted to different learning situations (Day, 1994). Sungar (2007) concurs that students trained in metacognition and strategic thinking have learned to "emphasize planning and monitoring one's learning and being aware of which strategies are suitable for use across academic tasks" (Sungur, p. 315). Therefore, the successful strategic thinker has internalized the value of learning in addition to factual knowledge. She may also learns to control the outcome of endeavors through metacognition and self-efficacy—the capacity to learn proficiently (Sungur, 2007).

Kramarski, et.al.'s study (2001) of multilevel metacognitive training (MMT) submits that cross-domain training strenghtens strategic thinking skill. Their research hypothesizes that students receiving MMT would successfully generalize strategic thinking skills from one domain to another. They found that students not only internalized the methodology, but also effectively modified and adapted techniques between mathematics and English classes. The study partcipants learned to analyze problems, activate prior knowledge, and select appropriate strategies (Kramakski, Mevarach, & Lieberman, 2001). Engle's (2006) study of fifth graders also directly addressed skill transfer and generalization. Her findings support the Kramarski, et.al's(2001) conclusion that skills may be transferrable from one domain to another. However, Engle's procedure contrasts with cognitive models that rely upon what students do or say.

Instead, Engle believes that the educational setting, or stituational context, determines the level of transfer. She found that "transfer is more likely to occur when learning contexts are framed as part of a larger ongoing intellectural conversation in which students are actively involved" (Engle, p. 451). She continues that, "generative learning—learning that results in the flexible use of what has been learned in a wide range of relevant future situations" has a greater impact on generalization (Engle, p. 451). She believes that intercontextuality is essential and hypothesizes that the learning environment must be designed to enhance transfer to a larger intellectual venue.

Summary

Metacognitive awareness provides the framework for building strategic thinking skills. Current research indicates that training students in strategic thinking has wider application in the classroom and the community. Through direct and explicit instruction in these skills, students lay the foundation for thoughtful, critical, and independent learning. They develop the ability to make decisions, solve problems, draw conclusions, analyze information, and identify cause and effect. In short, students may increase their academic proficiency and become self-regulated, autonomous learners who have the skills to direct their own learning. As noted in the cited research, acquiring these skills goes beyond single-subject competency. Students who have developed metacognitive awareness and efficient learning strategies may be able to transfer or generalize from one specific domain to another. However, further research needs to be done in facilitating the integration of strategic instruction into classrooms. As Beyer (2008) notes, "there are gaps and omissions even in research that exists. Educational research is an ongoing enterprise changing with the educational interests of the times" (Beyer, p. 231).

Methodology

Promoting Strategic Thinking Skills in Middle-School Students Using *Set: The Family Game of Visual Perception*®

Research Question

The study addresses the following research question:

What are the effects, if any, of a curriculum using *Set: A Family Game of Visual Perception*® on strategic thinking skills in middle school students?

Research Design

An exploratory and qualitative, design with a specific instructional model was selected for this study. In addition, the study addressed the feasibility of using an alternative method of training students to be strategic thinkers using *Set: A Family Game of Visual Perception*®. The qualitative data collection was based on the researcher observations, student journals, student questionnaires, and audio tapes that record responses to the instruction. Permission was obtained from the creators of *Set: A Family Game of Visual Perception*® (Copyright ©1988, 1991 Cannei, LLC) *(*Appendix A). The study involved planning an instruction, taking action, and evaluating the results. It was participatory and may inform changes in the classroom curriculum, although this was not the purpose of this study. This research design generated a dynamic analysis of an instruction that I anticipated would build strategic thinking skills as manifested in *Set: A Family Game of Visual Perception*® in middle school students. I selected the Metacognitive Teaching Framework (MTF) as described by Kelley and Clausen-Grace (Kelley, 2008) as the foundation of my curriculum..

Metacognitive Teaching Framework

Many researchers and educators have designed methods for teaching metacognitive awareness and strategic thinking skills (Day, 1994; de Bruin, 2007; Joseph, 2006; Kramakski, Mevarach, & Lieberman, 2001; Rogers, 1994). The various methodologies employ similar steps as described in the literature review. However, for the purposes of this study the Metacognitive Teaching Framework*(MTF),* as described by Kelley and Clausen-Grace, was used (Kelley, 2008). MTF consists of three primary instructional phases:

- Phase One: the teacher models her own cognitive process, demonstrating examples of strategic thinking. Often referred to as the "think aloud" phase, the teacher explains how she might reach a particular goal or conclusion and models it. She may invite the students to ask questions or make suggestions about the procedure.
- Phase Two: The teacher monitors the student learning process and offers active guidance in strategic thinking skills by promoting questioning and self-assessment. She may ask clarifying questions about the participant's strategies and encourage exploring alternative processes.
- Phase Three: The participants act independently, developing strategies based on self-assessment and self-reflection. Participants may engage in self-talk with the other players. The researcher's primary role is to observe, analyze the play, and collect data. However, she may return to Phase Two to reinforce strategic thinking and offer guidance. Appendix J provides a more complete description of the curriculum.

Research Site

The site of the study was an independent school in Oakland, California. The head master of the middle school and parents signed a letters of consent authorizing the study (Appendices B

& C). Both the school and parent consent forms included a description of the study. The socio-economic status of the participants ranged from middle to upper class. The school is racially and ethnically diverse, including African-American, Asian, Latino, and Euro-American students.

Participants

Participants were six-middle-school students who attended the independent k-12 school in Oakland, California. Both sexes were equally represented with three girls and three boys. The racial and ethnic backgrounds were diverse. Parents or guardians were asked to sign consent forms that included a description of the study. Participant anonymity was maintained by assigning number codes for the student profile, questionnaires, and participant journals. The participants' homeroom teachers compiled individual participant profiles prior to instruction. The profile included the participant's age, grade, whether or not the participant had a diagnosed learning disability, and any educational support the student might be receiving. (Appendix D). Pseudonyms were used in the final discussion for both participants and the school.

Participant Selection

The participants selected the study as a bi-weekly, school sanctioned activity with parental consent. Participants met the following criteria:

1. Participants may have had teacher-perceived challenges in metacognitive awareness and strategic learning. However, challenges in these areas were not required.
2. Participants did not have had prior experience with the game, *Set: The Family Game of Visual Perception*®.
3. Participants enjoyed playing games and committed to the study voluntarily.
4. Participants' parent or guardian signed the "Letter of Consent" (Appendix B).

5. Participants had no more than one absence for the previous month and were able to commit to two weekly, 30-minute sessions for a total of fourteen sessions over a period of two months.

Data Collection

Participant Questionnaires

All participants answered eight pre-instruction, closed-ended questions, and one open-ended question. These included questions about participant knowledge of strategic thinking, their perceptions about their learning modalities, and prior knowledge of strategy games. The post-instruction questionnaire consisted of four closed-ended and four open-ended questions that asked the participants to evaluate the impact of the game on their strategic thinking skills and any perceived changes in academic performance (Appendix E and F).

Participant Journals

Participants maintained journals in which they recorded strategies, perceptions about the intervention, and other personal observations at the end of each week. The journal consisted of four closed-ended and four open-ended questions as well as any personal observations. The journals were used to generate focus group topics at the end of each session and to evaluate any potential changes in the participants' strategic thinking skills (Appendix G).

Researcher's Observation Log

The researcher maintained an informal observation log comprised of seven closed-ended entries and one open-ended entry for the researcher's subjective commentary and analysis. The researcher maintained a separate observation log for each participant who was observed once a week for a total of seven entries. The observation logs used the participants' pseudonym to protect anonymity. Subjective commentary and observations included, but was not be limited to

student-to-student interactions, questions that the participant asked of the researcher and other players during play and group discussions, social interactions, and skill acquisition. Data was collected during game playing and post-play discussion used an audio recording (Appendix H).

Photographs

The researcher took photographs of the participants' card arrays during the initial card sorting activity. The participants' faces were not part of the photographs in order to protect their anonymity. The photographs were part of the researcher's process journal.

Audio recordings

Audio recordings of the participants were made during the play and the focus group. The researcher used them to supplement the researcher's process journal.

Researcher Process Journal

The researcher's process journal was be used to collect observations about the participants' group interactions, their teaching and learning strategies, changes, or modifications of the researcher's instruction strategies, and analysis of participants' cognitive process. The process journal includes photographs and audio recordings. The photographs focused on the participants' hands, and the card array.

Instructional Materials

The instruction relied upon *Set: The Family Game of Visual Perception*®, which provides a concrete and hands-on experience. The game focused on strategy development, visospatial competency, working memory, and organizational skills. The card game consists of eighty-one cards with four variable features:

- Symbols—One of the following: ovals, squiggles, or diamonds
- Colors—Symbols are either red, green, or purple

- Number—Each card has one, two, or three symbols
- Shading—Symbols are either solid color, striped, or outlined with one of three colors

Below are examples of the variables:

The object of the game is to select three cards from a grid that constitute as set. The grid begins with twelve cards. Three additional cards are added when a set is discovered and removed, or when there is no set in the grid. Sets rely on a combination of differences and similarities in symbols, colors, number of symbols, and shading. The game continues until all the cards have been used and no further sets can be constructed. The player with the most sets is declared the winner. The participants receive a rule sheet that contains examples of what constitutes a set (Appendix I). *Set*® may support direct development of language and math-relevant skills sets and strategies by using a concrete cognitive activity. However, the successful player must use metacognitive and strategic thinking skills to become proficient in the game. The purpose of the study is to explore the effect of the game on the following:

- Abstract reasoning as it applies to strategy development through card set sorting
- Working and long-term memory as it applies holding types of sets in memory and learning rules
- Organizational skills as it applies to sorting by symbols, numbers, colors, and shadings
- Metacognitive awareness as it applies to student evaluation and comprehension of strategic thinking

Procedures

The instruction was divided into three segments: (a) pre-instruction assessment using the pre-instruction participant questionnaire (b) training by the researcher and independent play, and (c) post-instruction assessment using the post-instruction questionnaire. Participants met with the researcher twice weekly for two-thirty minutes sessions for seven weeks for a total of fourteen sessions. The original study design included an optional sixteenth session for the participants to train their classmates in playing *Set*®. However, the anticipated eight weeks was reduced to seven. Therefore, supervised student-to-student training did not occur.

The instruction used the metacognitive teaching framework (MTF) as described by Kelly and Clausen-Grace (2008). This model encourages and may train participants to think actively about strategies that they might employ to become competent players. This is in contrast to a cognitive model that teaches the rules and application without developing strategic thinking skills. During the first stage, the researcher explicitly instructs the participants by demonstrating and defining strategies needed for knowledge acquisition. This includes a description of the researcher's own strategies in identifying sets. The researcher and participants then perform the task together through guided practice in which the researcher oversees play and continues direct instruction. Finally, the participants practice independently as they gain confidence and competency in specific skill sets required for playing the game. During the last phase, the researcher passively observes the participants although she may answer specific questions about the game. Pre-instruction requires an informal assessment of the participants using the pre-instruction teacher and participant questionnaires. The participant questionnaire was designed to determine participant awareness of strategic thinking and individual learning styles. The

researcher scored each assessment and entered the results onto the data collection log. See Appendix J for the complete curriculum.

Data Analysis

Participant Profile

The student profile was used to collect demographic and educational data on each participant. The profile included information on the participants' possible learning challenges, interventions, and other educational support services. The results were compiled and used to create a comprehensive comparative profile of the participants.

Participant Questionnaires

All participants answered short, closed-ended, and open-ended questions at the beginning and end of the instruction. The pre-instruction questionnaires were evaluated for the participants' familiarity with strategy games, understanding of learning modalities and knowledge of strategic learning skills. The post-instruction questionnaire was used to assess types of strategies employed during the study, ability to describe and teach the game to others, participant-perceived changes, desire to continue playing *Set*®. In addition, the post-instruction questionnaires were evaluated for participant perceptions about the success of the instruction and perceived transfer effects (Appendix F, G, and H). The results of the pre-and post-instruction participant questionnaires were compared for perceived changes in strategic thinking abilities, participant possible generalization effects. These were compared with the researcher's log and process journal to provide a more comprehensive evaluation of possible changes in the participants' strategic thinking and learning skills.

Participant Journals

Participants maintained journals in which they recorded strategies, perceptions about the intervention, and other personal observations at the end of each session. The journals were used collect data about the participants' evolving strategies, perceptions regarding proficiency, and possible transfer to academic endeavors (Appendix I). The daily participant journals were triangulated with the researcher's individual participant logs and process journal for similarities and differences in perception.

Researcher's Observation Log

The researcher maintained an informal observation log comprised of seven closed-ended entries and one open-ended entry. Each participant had a separate data entry form. The log also included the researcher's subjective commentary and analysis about the individual participants. The log was used to evaluate individual participant skill acquisition. They were triangulated with the participant journals and questionnaires.

Photographs

The researcher photographed the card arrays during the first phase of the instruction. The purpose was to illustrate the participants' different methods for sorting the cards. Analysis of the different sorting methods was noted in the researcher's process log but not be tabulated. The participants' faces were not photographed.

Audio recordings

The researcher recorded participant interactions during actual play and the focus group. The purpose was to provide data supporting the researcher's observations in the process journal. The recordings were not tabulated.

Researcher's Process Journal

Observations included, but were not limited to, student-to-student interactions, questions that the participant asked, social interactions, skill acquisition, and the researcher's notes. Data was collected during both game playing and post-play focus group. The purpose of the data was to maintain an informal record of the instruction and analysis. Information from the process journal entries was used in the final narrative but was not be tabulated.

Data Collection and Tabulation

The data collected was entered onto tables that recorded perceived difficulty in learning the game, types of strategies used, perceived mastery, and potential application of strategic thinking in academic endeavors. Data from the participant profiles, including demographics and learning challenges were also compiled in a separate table. Finally, a narrative summary of the researcher's informal observations has been included. The researcher used a process journal and the audio recordings as part of final discussion.

Set® Study Results

Introduction: Metacognitive awareness and strategic thinking are central to a student's academic success (Beyer, 2008; Protheroe, 2008; Vaidya, 1999). Students not only need to learn to decode, recode, and organize information; they need to be able to analyze, interpret, and apply knowledge to both academics and the outside world. Fostering metacognitive knowledge and self-awareness in middle school students takes many forms. It can be modeled through a specific task in which the students learn to plan, monitor, evaluate, and reflect upon their work. The purpose of this study was to investigate teaching strategic thinking skills to middle school students through playing *Set: A Family Game of Visual Perception*®. The researcher employed a metacognitive model to facilitate the acquisition of these skills. The study included engaging students in collaborative planning, self- assessment, and collective reflection with the stated goal of improving strategic thinking skills through metacognitive awareness.

This study proposed an alternative method for teaching strategic thinking skills through direct instruction using the strategy card game, *Set: The Family Game of Visual Perception*®. I anticipated that participants would become more proficient in using strategic thinking, an essential skill in most academic endeavors, as they master *Set*®. I hypothesized that acquired expertise would be reflected in the ability to apply *Set*® strategies automatically as the participants began to master the game. I also predicted that participants would gain a better understanding of strategic thinking and their individual learning styles. Further, I expected that participants would perceive an improvement in their strategic thinking abilities in their academic classes. However, transfer or generalization of strategic thinking skills to the classroom is outside the scope of this study. Consequently, analysis of strategic thinking skills was confined to the game.

Description: The study engaged students in collaborative planning, self- assessment, and collective reflection with the stated goal of improving strategic thinking skills through metacognitive awareness. Assessment tools included pre-and post intervention student questionnaires (Appendices E and F), weekly student journal entries, weekly group discussions, and researcher observations of each student. Audio recordings and a researcher process journal supported these.

The instruction used the Metacognitive Teaching Framework (MTF) as described by Kelley and Clausen-Grace (2008). The MTF has three phases of instruction:

- Phase One: During the first week, the researcher actively modeled her own cognitive process, demonstrating examples of strategic thinking. Often referred to as the "think aloud" phase, the researcher explained how she might reach a particular goal or conclusion and invited the students to ask questions or make suggestions about the procedure. The researcher returned to phase one throughout the study to encourage the participants to engage in metacognitive thinking.
- Phase Two: During weeks two through four, The researcher monitored the student learning process and offered active guidance in strategic thinking skills by promoting questioning and self-assessment. She asked clarifying questions about the participant's strategies and encouraged exploring alternative processes. The researcher also joined games in order to model strategies and to assess participants' cognitive processes and comprehension.
- Phase Three: During weeks five through seven, the participants acted independently, developing strategies based on self-assessment and self-reflection. Participants engaged in self-talk with the other players. The researcher's primary role during this phase was to

observe, analyze the play, and collect data. However, she sometimes returned to Phases One and Two to reinforce strategic thinking and offer guidance.

Many of the interactions amongst the participants and the researcher were recorded and became part of the researcher's process journal and study results.

Modifications of the Original Study

1. The qualitative data collection used the researcher's observations, student journals, student questionnaires, and audio tapes to record responses to the instruction. Because of the small sample, the researcher determined that six limited case studies provided the most comprehensive means of data analysis.
2. The study took place during twice-weekly, school-scheduled activity periods. The activity rotation generally lasts for eight weeks; however, the winter rotation was reduced to seven weeks. Consequently, the length of the study was reduced. The researcher believes that this did not affect the results, as the last two days of the study originally consisted of filling out post-study questionnaires and teaching their classmates the game. The post-study questionnaire was completed two weeks after the end of the study
3. During the third week, the researcher changed one of the two weekly sessions by giving each participant his or her own deck and asking them to engage in solo play. The purpose was two-fold: First, single play aided in stress reduction experienced by some participants when playing in pairs and quartets. Secondly, individual play gave slower processers adequate time to assimilate the rules and types of sets.

Assessment Tools and Data Collection

Assessment tools included pre-and post intervention student questionnaires (Appendices E and F), weekly student journal entries, weekly group discussions, and researcher observations of each student. Audio recordings, photographs, and a researcher process journal supported these tools. The audio recordings were the source of many of the direct quotations used in the case studies.

Samples of student and researcher journals are included in appendices K and L. Data for each student was assessed individually and presented as individual case studies. The researcher entered data into two types of tables. Tables one through four present demographics, previous experience with strategy games, playing partnerships, and comparative post-instruction data. Tables five through fourteen tabulate individual participant's journal entries and post-instruction data. The following tables are based upon the student profiles, pre-instruction questionnaires, student journals, and post-instruction questionnaires. These tables tabulate the results for all participants. Individual participants' tables are incorporated into each case study.

Demographics

The participants' families range from middle to upper class economically. The teachers provided this information. According to the participants, their parents are well-educated professionals who place a high value on family time and education.

Table 1—Demographics and Self-Knowledge about Strategies

Name	Age	Grade	Sex	Race/Ethnicity	Learning Disability	Knows Learning Modality	Understands Learning Strategies
Blaine	12	6	Male	Mixed Race	None	Yes	Yes
Evan	12	6	Male	Euroamerican	Dysgraphia/Exec.Function/ Processing speed	Yes	Somewhat
Joelle	12	6	Female	Euroamerican	None	Yes	Yes

Name	Age	Grade	Sex	Race/Ethnicity	Learning Disability	Knows Learning Modality	Understands Learning Strategies
Lincoln	11	6	Male	Amerasian	ADHD/Social	Yes	Yes
Melinda	11	6	Female	Asian	None	Yes	No
Rowena	12	6	Female	South Asian	None	Yes	No

Previous Strategy Game Experience

Informal conversations during play indicate that parents closely monitored and restricted television and video game time. All of the participants indicated in their post-study questionnaires that they spent time playing board and card games with both parents and/ siblings. Joelle and Melinda showed a preference for playing non-computer games that included those listed in the table as well as *Scrabble*™, *Clue*™, *Life*™, and various card games. As a result, the participants had a high level of experience with non-computer games.

Table 2—Previous Strategy Games Played by Participants

Name	Chess	Checkers	Battleship	Mastermind	Risk	Bridge	Jenga
Blaine	x	x	x	x			x
Evan	x	x	x	x			x
Joelle	x	x	x	x			x
Lincoln	x	x	x	x		x	
Melinda	x	x	x	x			
Rowena	x	x	x	x	x		

Patterns and Partners of Play

The researcher created a partner rotation system for the first four weeks. During the exploration phase in the first week, participants were divided by sex. The purpose of the subsequent rotation model was to expose each participant to different learning styles and strategies. In addition, different groupings took them out of their respective comfort zones and friendship groups. These pairings also allowed for mixed sex groupings, which the participants were reluctant to initiate. Finally, Lincoln, who experienced isolation and was socially awkward, benefitted from not waiting to be chosen. Participants played by themselves for the first session of the third week and collaborated during the second session of that week. The participants chose their partners for competitive play during the last three weeks. The groupings were fluid and the participants frequently changed the configuration, using dyads, triads, and quartets. Participants also observed others engaged in play and added commentary. Audio tapes were made of the interactions.

Table 3—Playing Partners

Week 1 Assigned	Week 2 Assigned	Week 3 Assigned	Week 4 Assigned	Week 5 Self-Selected	Week 6 Self-Selected	Week 7 Self-Selected
Melinda, Joelle, & Rowena	Lincoln & Joelle	Joelle & Blaine	Melinda & Lincoln	Joelle & Lincoln	Joelle, Rowena & Melinda	Joelle, Rowena & Melinda
Blaine, Evan, Lincoln	Evan & Blaine	Evan & Melinda	Rowena & Blaine	Blaine & Evan	Lincoln & Blaine	Lincoln, Evan, & Blaine
	Rowena & Melinda	Rowena & Lincoln	Joelle & Evan	Rowena & Melinda	Joelle & Lincoln	Lincoln, Joelle, Melinda, & Rowena
				Melinda & Joelle	Melinda & Rowena	Lincoln & Rowena

Table 4—Comparative Data for Post Instruction Questionnaire

	Can Explain Rules	Describe Strategies	Better Strategic Thinker	Changed Strategies	Strategies Used
Blaine	No	Sometimes	Sometimes	Sometimes	Process of Elimination/colors
Evan	No	Sometimes	No	Yes	Overview and Elimination
Joelle	Yes	Yes	Yes	No	Looked for differences and odd one out
Lincoln	Yes	Yes	Sometimes	No	Color and shape
Melinda	Yes	Sometimes	Yes	Yes	Odd balls and differences
Rowena	Yes	Sometimes	No	Yes	Similarities, fillings

The comparative post instruction questionnaire suggests that all of the participants began to develop the ability to recognize and articulate strategic thinking skills. However, two of the participants stated that they had trouble with explaining the rules. In Evan's case, this is consistent with his organizational challenges, which were diagnosed after the study. Blaine, on the other hand, was able to explain the rules when directly questioned by the researcher. All of the participants were able to describe their strategies to the researcher when directly questioned. Overall, the participants exhibited changes in their strategic thinking skills.

Case Studies

The following is the key for the individual case study tables:

Key:

N—Never	A--Always	B-Beginner
R—Rarely		G-Good
S—Sometimes		P-Proficient
O—Often		M-Master

Blaine

Blaine is a mixed-race, sixth grade boy who physically towers over his classmates. His stocky body resembles a lumbering bear and he says that he is not very athletic. Blaine is affable, self-deprecating, and lacks self-esteem as well as self-confidence. He agreed with the researcher's assessment and when asked, defined "self-deprecating" accurately. He emphatically declared that he would never have self-confidence because he was not good at anything. As a result, he was convinced that he would never learn how to play *Set*®. Informal conversations with his classroom teachers supported these observations. However, the teachers added that Blaine is a good student who works hard. He has a well-developed sense of humor and appears to be well liked by his peers. These traits were most evident when he was around his best friend, Evan, who usually took control of their joint interactions with both adults and peers. Blaine decided to participate in the study because Evan thought that it sounded like fun. When Evan decided that he was not enjoying himself, Blaine reflected that attitude. As a result, Blaine initially exhibited disinterest in the game because of Evan's influence. However, the researcher found that splitting the boys up and assigning them different partners allowed Blaine to become more engaged and vocal. He particularly enjoyed playing with Joelle and Lincoln.

Blaine stated that he did not use strategies; however, his journal entries belie that belief. During the first week's exploration phase, he engaged in random card play with Evan, spreading up to half of the deck out on the floor and creating designs unrelated to the rules of the game. They also invented a way to play poker using the cards but could not explain the rules of their invented game to anyone else. Both of these activities provided a way for them to become familiar with the deck. Blaine and Evan insisted that the large card array did not deter them from identifying sets and that they had a system. As with the poker game, neither boy could explain the strategy nor, when asked, to find a set.

After the first week, the researcher joined Blaine and Evan's game and began modeling strategies. She suggested that too many cards might be visually confusing or overwhelming. Evan disengaged from the process, but Blaine became intent on the game. He finally suggested that all but twelve cards be removed. As a result, Blaine began to see patterns and develop a strategy. He would first find two cards that fit the criteria and then search for one that would complete the set. If one was not present, the researcher would ask him what variables he needed. By the end of the second week, Blaine was able to analyze the cards, extrapolate information, and apply it.

According to the researcher, Blaine continued to integrate skills and become a more proficient player. She believes that Blaine's playing with participants other than Evan impacted his outcome. He particularly liked playing with Joelle, "because she's a challenge and it's more fun" (audio recording). He began to discuss his strategies with fellow participants and make suggestions. His journal entries went from "I don't use any strategies" to noting, "I pay attention to new cards first, then I look at colors." His final journal entry reflected his growing understanding through a series of arrows that attach the type of symbol to whether he sees the similarities or differences first. For instance, when looking at types of fillings and number of symbols, he sees the differences first. On the other hand, he sees the same colors first. The types of shapes are the least relevant for him. Despite these changes, Blaine did not believe that he had become more proficient and that his strategies had changed. This is consistent with Blaine's self-perception that he is not a good student as well as supporting the researcher's observations about his self-confidence and self-esteem. However, he stated that he sometimes uses strategic thinking in the classroom because "I know more about how to do it" (audio recording).

Table 4—Blaine's Journal Entries

Strategies	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Color			x	x	x		x
Number						x	x
Shape	x	x			x		
Fillings				x	x		x
Similarities	x	x		x	x		x
Differences			x	x	x	x	x
Self-rating	B	B	B	B	B	B	B/G
Peer Discussion	No	No	No	Sometimes	Yes	Yes	Yes
Improving		No	No	No	Yes	Yes	No
Better Strategic Thinker.		No	No	No	No	No	No
Classroom Use of Strategies	Rarely	Rarely	Sometimes	Sometimes	Sometimes	Sometimes	Sometimes

Table 5—Blaine Post-Instruction Results

Continue to Play	Explain Rules	Describe Strategies	Better Strategic Thinker	Change in Strategies	Strategies Used
No	No	Sometimes	Sometimes	Sometimes	Process of Elimination/colors

Evan

Evan epitomizes the quintessential middle school boy. He is average height, somewhat stocky and has unremarkable features. He loves computer games, sports, and prefers socializing to academics. Evan prefers physical activity to sitting still and often engages in rough housing with his best friend, Blaine. He tends to express his feelings with physical reactions including wrestling, moving chairs and desks from place to place, and chasing other children. He likes to be in charge and often models the desired attitude for Blaine. Although Evan appears to be the leader of the two, he relies primarily on Blaine for companionship and validation. As a result, he became truculent as well as uncommunicative and withdrawn when assigned to other participants beginning in the second week. Additionally, the activity failed to meet his expectations because it did not use computers, although the course description explicitly stated that they would be playing a non-computerized game. As the study progressed, Evan returned to active participation and cooperation. In his case, *Set*® may have been more effective as a diagnostic tool.

Although Evan did not have a diagnosed learning disability, his teachers noted that he had graphomotor problems. Graphomotor, or dysgraphia, can be linked to visual processing problems and spatial organization, both skills necessary for succeeding at *Set*®. The researcher's observations also suggested that Evan may have an executive function deficit, as he appeared to have trouble processing and using information efficiently, holding information in his working memory, and organizing it into a coherent form. He covered his inability to grasp the rules of the game by declaring that, "This game is stupid and doesn't make sense" (Researcher's Log). During the card sorting activity in Phase One, Evan resisted help and insisted that he was ready to play without preliminary instruction. However, he quickly became frustrated when he could not identify sets. A further indication of disordered thinking occurred when he and Blaine

created their disorganized array, which suggested challenges with organization, self-regulation, and self-awareness.[5] While Blaine recognized and corrected the problem, Evan did not. Instead, he tried to distract Blaine and eventually withdrew for a brief time.

Evan's pre-instruction questionnaire provided insights into his self-perception. He states "I don't learn much in school," and "I sorta know what learning strategies are," However, when asked to describe a specific learning strategy, he said that meant he had to "pay attention and don't talk too much" (student journal). He also recognized that he learned better, when he engaged in physical activity and through touching and manipulating objects. Evan's overall experience with the study yielded few concrete results. He consistently marked all of the boxes in his journal entries and spent little time evaluating his performance. The researcher suggests that this may be due to his possible problems with organizing and evaluating information. His answers changed during week five. He began adding comments to his journals that indicated that he was beginning to observe his strategies and apply them. He noted that he did an overview and then eliminated colors until he found a set. The following week he stated that "knowing what the filling is helps. The number and the filling help." He became an active and positive participant rather than a dissatisfied player. He also discovered that competitive play drove him to concentrate on what he needed to win. Evan's post-instruction questionnaire suggests that he benefitted from instruction, but may require direct training in strategic thinking for the classroom work .

Table 6—Evan's Journal Entries

Strategies	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Color	x	x	x	x	x	x	x

[5] Shortly after the study, Evan was assessed for specific learning disabilities. Test results indicated that he has an executive function, attention deficit disorder, and problems with processing speed.

Number	x	x	x	x	x		x
Strategies	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Shape	x	x	x	x	x		x
Similarities	x	x	x	x	x	x	x
Differences	x	x	x	x	x		x
Self-rating	B	B	B	B	B	B	B
Discussion	No	No	No	No	Yes	No	No
Improving		No	No	No	Yes	No	No
Classroom Use of Strategies	N	N	N	N	No re-sponse	N	N

Table 7—Evan—Post-Instruction Results

Continue to Play	Explain Rules	Describe Strategies	Better Strategic Thinker	Change in Strategies	Strategies Used
No	Sometimes	No	No	Yes	Overview/process of Elimination

Joelle

Joelle's effervescent personality permeated the room. She consistently radiated a positive energy that affected all of the participants with the exception of Evan. She perceives of herself as a good student with an ability to learn. She approached the study with enthusiasm and expressed excitement about being involved, an attitude that infected the others girls in particular. Joelle's assertiveness occasionally edged into bossiness, which manifested during the Session One sorting activity. She initially took control and insisted that her strategies were more efficient; however, the researcher suggested that the other girls might have equally good ideas. Joelle concurred with good humor and adjusted to a more cooperative model, thereby mitigating

any negative impact. She also exhibited an emotional maturity that recognized Lincoln's social awkwardness and led her to request him as a partner during the instruction phase. Her willingness to include Lincoln spilled over onto Rowena and Melinda. Joelle's overall style was one of inclusion and recognition. She acknowledged Rowena's learning style, which involved observation and instruction prior to play. Joelle also tapped into Melinda's competitive nature, an aspect that made Joelle a fierce competitor. Finally, although it was not her preference, she played with Blaine and encouraged him by noticing his strengths just as she recognized her own.

Joelle came to the study with a well-developed self-awareness. Her pre-instruction questionnaire indicated that she enjoyed strategy games and understood her learning modalities; that she learned best by visualizing and through touching or manipulating items, both skills used when playing *Set*®. Her contributions to the first group discussion indicated that she understood metacognition and strategic thinking. She defined these as "a way to think about how I learn best and use it." She indicated that she often thought about how she thinks and learns, and then applied it to the classroom, particularly in math and science.

Joelle self-assurance may have prevented her from exploring different strategies for finding sets. She stated that, "I know what works for me, so I don't have to try anything else" (audio recording). This rigidity may interfere with obtaining optimal academic functioning and is an area that might be explored with her. She added that, "I always look for differences because I think that they are the easiest." She also employed looking for the "odd one out," strategies she shared with Melinda, her favorite competitor. In addition, she explained this strategy to Blaine, Rowena, and Lincoln, who incorporated the strategy into their own play. Joelle played for the joy of competition and stated that it "makes my brain work harder and

faster" (student journal). Joelle anticipates continued play with Melinda and wants to teach *Set*® to other classmates.

Table 8—Joelle's Journal Entries

Strategies	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Color		x					
Number							
Shape							
Fillings	x		x	x	x	x	x
Similarities							
Differences	x	x	x	x	x	x	x
Self-rating	P	P	M	P	P	P	P
Discussion	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Improving	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Classroom Use of Strategies	S	S	A	S	S	S	S

Table 8—Joelle-Post-Instruction Results

Continue to Play	Explain Rules	Describe Strategies	Better Strategic Thinker	Change in Strategies	Strategies Used
yes	Yes	Yes	Yes	No	Differences/Odd one out

Lincoln

Lincoln, an Amerasian boy, stands about 4'6" and is considerably smaller and slighter than his peers. His behavior tends to be odd and quirky, traits that alienate him from his

classmates. He inserts non-sequitors into conversations, often sharing random bits of information with his baffled classmates. Lincoln related better to adults and took great pleasure in showing the researcher how he could write his name using numbers on a calculator. He transferred this skill to his first two journal entries by writing his name upside down and backward. Lincoln sought out the researcher in order to share his family background. The purpose may have been to explain his social difficulties. He is the oldest of three children with an Asian mother and a Euroamerican father. He referred to his mother as a "tiger mother."[6] According to Lincoln, his parents are strict and do not encourage outside activities including play dates and sports. He plays piano and attends Chinese school. In addition, his parents limit time playing computer games one to two hours each weekend. Lincoln insisted that this prevented him from socializing with other boys who, in his mind, had unlimited access to computer games. Instead, he has become proficient at chess, bridge, and checkers, which he plays with his family. Lincoln was diagnosed with attention deficit disorder, inattentive type in 2009. He is currently seeing a therapist to address the ADD and social issues.

Lincoln's teachers have observed his difficulties with social cues and interactions. They note that he may self-isolate in order to protect himself. His social awkwardness creates distance between him and his classmates and he seldom initiates conversations. When he attempts to join one, his eyes dart anxiously from face to face and his brow furrows. As noted above, he often makes random and unrelated comments that invite puzzlement and sometimes derision. Female and male participants response to Lincoln differed. The female participants initially ignored him. However, as the study progressed, Joelle invited him to play with her, although she preferred other partners. The researcher noted that the male participants actively excluded him.

[6] The term "Tiger Mother" comes from a book that is currently popular and describes a rigid approach to child-rearing that excludes social interactions and emphasizes academics and music.

This isolation became evident during the pre-instruction sorting activity when the participants grouped by sex. Evan and Blaine consciously excluded Lincoln by turning their backs on him and refusing to include him in decisions. Lincoln responded by taking one-third of the deck and sorting it on his own. When he tried to integrate his cards with the other boys' piles, his ideas were rejected as being "stupid" and not making sense (Researcher's Process Journal). The researcher noted that Lincoln's criteria and evaluation of the cards was logical. However, Lincoln's social struggles interfered with communicating his ideas effectively. The researcher intervened in an effort to include Lincoln in the process, a request to which Blaine and Evan reluctantly compiled.

Lincoln's work with his therapist was evidenced by his familiarity with learning strategies and modalities. He actively applied his knowledge during the study by giving thoughtful and insightful answers to the journal's open-ended questions and his entries became more complex each week. He moved from single word entries such as "patterns" or a slashed circle with similarities written in the middle to more complex analysis. In addition, he consistently exhibited metacognitive awareness during play and in post-session discussions. In this context, he began to engage in appropriate dialogue with individuals in his game group. He demonstrated flexible thinking, an important component of strategic thinking. Lincoln noted that his strategies changed with each game because the factors differed. He noticed by week six that "What I see depends on the beginning of the game…I look for choices that match the facts and then put them together" (journal entry). He recognized that he needed to make strategic changes in order to enjoy success at the game. By weeks six and seven, Lincoln began to refine his strategies by numbering card components in order of importance. In short, he began to analyze his work product. His entry for the final session notes, "At first I see similarities, then I get

flexible in the middle, then stiffen towards the end." Lincoln's journal entries support these shifts. However, his post instruction questionnaire indicates that he did not recognize these shifts as changes in his strategic thinking.

Table 9—Lincoln's Journal Entries

Strategies	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6*	Week 7*
Color			x	x	x	2	x
Number	x					3	x
Shape		x				1	
Fillings					x	4	x
Similarities		x	x	x	x	1	1
Differences	x	x			x	2	2
Self-rating	G	G	G	G	G	G	G
Discussion	No	Yes	Yes	Yes	Yes	Yes	Yes
Improving	Yes	Yes	Yes	Yes	No	No	Yes
Classroom Use of Strategies	S	S	S	S	R	R	R

*Rank order numbering showing what he looks for first, second, third, and fourth

Table 10-Lincoln Post-Instruction Results

Continue to Play?	Explain Rules	Describe Strategies	Better Strategic Thinker	Change in Strategies	Strategies Used
Maybe	Yes	Yes	Sometimes	No	Color and shape

Melinda

Melinda's intensity matched Joelle's exuberance. Both girls pursued academic excellence and said that they enjoyed learning anything new. Melinda's pre-instruction questionnaire indicated that she did not know what learning strategies were. However, during the discussion period, she provided an example of a successful math strategy in which, "when I am adding, I look for groups that add up to ten" (journal entry and discussion group). She proceeded to explain the method to the rest of the students. She added that thinking about how she learns helps her academically. Additionally, Melinda described her learning modalities as visual and auditory. She said, "I take notes in class to stay attentive and I also ask questions to stay engaged." (audio recording). She also noted that she learns best by doing rather than discussing. Her approach to *Set*® supported this, as she preferred showing her partners how to construct a set rather than trying to explain it.

Melinda proved to be a flexible thinker and learner, willing to change her approach if another one proved to be more efficient. In her final evaluation of the study, she emphasized that is was important to, "try different strategies in the beginning." During Phase Two when players were learning and integrating *Set's*® rules, she experimented with different strategies, "because the sets I see change depend on what cards are laid down" (journal entry). Melinda's strategy proceeded methodically. First, she did an overview and mentally eliminated components by identifying the oddball card, then she selected one element on which to focus. Finally, she put a set together.. As the study progressed, these steps became automatic and by week four when competitive play began, Melinda recognized that she did better when focusing on differences and color. She noted that her strategies had changed from the beginning and stated that. "At first I was just looking at the new cards" (journal entry). Ultimately, she devised new strategies that

allowed her to process information faster and more efficiently. By the fourth week, Melinda believed that she had mastered the game and looked forward to competing against Joelle. Like her friend, she has decided that she will continue to play, "because it is fun and because it helps me think faster in school" (post-instruction questionnaire).

Table 13—Melinda's Journal Entries

Strategies	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Color	x	x	x	x	x		x
Number	x	x	x			x	
Shape	x	x	x				x
Fillings	x	x	x		x		
Similarities							
Differences	x	x	x	x	x	x	x
Self-rating	P	P	P	M	M	M	M
Discussion	Yes	No	No	No			
Improving	Yes	Yes	Yes	Yes	Yes		
Classroom Use of Strategies	O	S	S	S	O	S	O

Table 12—Melinda Post-Instruction Results

Continue to Play	Explain Rules	Describe Strategies	Better Strategic Thinker	Change in Strategies	Strategies Used
Yes	Yes	Sometimes	Yes	Yes	Differences/odd ball

Rowena

Rowena's quiet demeanor masked her attentiveness to any task. She often appeared to be disinterested and disconnected when, in fact, she was observing. She frequently perched on a stool overlooking a *Set*® game in progress, preferring to watch rather than actively participate. Occasionally, she would get up and walk around the room in order to watch other people play. She did not join in discussions and answered questions posed by the researcher only when asked directly. Despite this, she absorbed the game and became a proficient player. Rowena's teachers believe that she may have some minor, undiagnosed learning disabilities. However, they do not appear to affect her learning significantly. Her homeroom teacher also noted that Rowena tends towards perfection, which, in turn, causes her to process slowly and methodically. Consequently, observation is a viable learning strategy for her because it provides an opportunity to incorporate visually new information prior to using it. Once the cognitive foundation is in place, Rowena says that, "I try something and then correct my mistakes" (student journal). As with some of the participants, she was unclear on what a learning strategy was prior to the study although she already incorporated them into her classroom work. She also stated that she sometimes thinks about how she thinks and learns but only when it is enquired.

Joelle and Melinda were Rowena's favorite partners and she disliked playing with any of the boys. She was most engaged when involved in a triad because, "I can watch and learn and I don't have to find the sets." (Audio recording). When separated from her friends, Rowena performed reluctantly but well. The researcher found that her intervention and direction helped Rowena to internalize the rules and to recognize what strategies she might use. Rowena quickly learned that she saw similarities more readily, particularly with the symbols solid, striped, or empty fillings. She became bored easily and requested a different game. The researcher

recognized that different strategy games may be more effective for some individuals, but explained that these could not be included as part of the study. Like other participants, Rowena began to analyze and incorporate her strategies by the fourth week. She noticed that, "I look for sets that have stripes in them first" (journal entry). By the fifth week, she stated that she was becoming a better *Set*® player and joined in more frequently. Rowena concluded that her strategies had changed and that, "I used to look for colors, now I look for fillings" (journal entry). She joined Melinda and Joelle in wanting to continue to play *Set*® at home and at school. However, she is not particularly interested in the other girls level of competitiveness as she believes that, "I can't think as fast as them so I always lose" (audio recording).

Table 13—Rowena's Journal Entries

Strategies	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Color		x					
Number	x	x					
Shape		x		x			
Filling			x	x	x	x	x
Similarities	x	x	x	x	x	x	x
Differences							
Self-rating	G	G	G	G	G	G	G
Discussion	No	No	No	No	No	No	No
Improving	Yes	Don't Know	Yes	Don't Know	Yes	No	Yes
Classroom Use of Strategies	S	S	S	S	S	S	S

Table 14—Rowena Post-Instruction Questionnaire

Continue to Play	Explain Rules	Describe Strategies	Better Strategic Thinker	Changed Strategies	Strategies Used
Maybe	Yes	Sometimes	No	Yes	Similarities/Fillings/Color

Summary

The purpose of this study was to investigate an alternative method of teaching strategic thinking skills to middle school students through playing *Set: A Family Game of Visual Perception*®. The researcher selected an exploratory and qualitative design with a specific instructional model. In addition, the study addressed the feasibility of using an alternative method of training using *Set* ®. The qualitative data collection was based on the researcher observations, student journals, student questionnaires, and audio tapes that recorded responses to the instruction. The researcher began with the premise that individuals could acquire and develop strategic thinking skills through playing *Set* ®. She anticipated that participants would become more proficient in using strategic thinking as they mastered the game. She also predicted that participants would gain a better understanding of strategic thinking and metacognition. She further hypothesized that as they acquired expertise, the participants would gain an ability to apply strategies to the game automatically. Finally, she expected that participants would perceive an improvement in their strategic thinking abilities and begin to use them in their academic classes. The results indicate that these goals may have been achieved. Formal assessments of strategic thinking skills may further support the results.

Although the sample size was small, the participants represented a diverse demographic, which may have compensated for the size of the study group. The participants included equal numbers of boys and girls as well as a varied racial and ethnic mix. In addition, the researcher

selected participants with varied learning modalities. Lincoln had been diagnosed with attention deficit disorder and social challenges, while Rowena and Evan had suspected learning disabilities. Joelle, Melinda, and Blaine balanced them out by having by no discernible learning challenges (Table 1). Finally, Evan, one of the participants, received a diagnosis of executive functioning disorder , slow processing speed, and attention deficit disorder when formally assessed post study. The researcher's informal assessment of this participant supported the diagnosis. As can be seen in Evan's case study, these challenges initially affected his performance. Despite this, Evan showed an improvement in his strategic thinking skills. By the end of the study, he was processing information more quickly and beginning to think strategically. The researcher speculates that Evan may benefit from continued training in strategic thinking as a means of remediation. Rowena also may have had undiagnosed challenges with processing speed. As with Evan, her processing speed increased during the study. She began to think about how she learned and how to apply that self-knowledge. As a result, she learned to enjoy the game.

As the researcher anticipated, the participants became more proficient in strategic thinking by the end of the study. A comparison of the journal entries indicated that they all made gains in strategic thinking and metacognition. Lincoln, Blaine, Rowena, and Evan's the journal entries became progressively more complex and thoughtful while Joelle and Melinda continued to make detailed entries that reflected their metacognitive awareness. By the fourth week, all participants began to engage in independent play with one another. They started to analyze the cards actively, extrapolate information, and apply it. In addition, the ability to recognize patterns and develop a strategy began to emerge. However, participants could not determine whether strategy use had transferred to their academics or improved their grades. Additional research in

this area is suggested. By week five, play became faster and more competitive indicating that the players had begun to integrate their strategies and apply them automatically. They became proficient in discussing their thought processes and were able to explain them to others. In spite of this, the participants did not recognize these shifts as changes in their strategic thinking. However, when the researcher began to question them more closely, most agreed that there had been a change both in their approach to the game and to their class work. The post-instruction questionnaire gave the participants an opportunity to analyze and discuss their experiences. Tables for each individual are included in the case studies. With the exception of Evan, the other participants indicated that they had seen an improvement in their ability to play the game. Interestingly, none of the participants recognized their strategy shifts as changes in strategic thinking.

The exploratory and qualitative design with a specific instructional model addressed the feasibility of using an alternative method of training students to be strategic thinkers. Despite the limitations, this study may provide the foundation for future studies in using non-computerized strategy games as a means of teaching strategic thinking skills. The researcher hopes that educators may be inspired to explore alternative methods of incorporating strategic training into their curricula. However, formulating clearer educational implications is not possible at this point without an experimental design. This study is a starting point for further exploration of strategic thinking and metacognitive awareness.

Discussion

I first became intrigued with using non-computer strategy games as teaching tools while teaching study skills classes and working with private clients. As a result, I began incorporating games like chess, checkers, backgammon, *Risk®, Battleship®,* and *Set: A Family Game of*

Visual Perception® into my curricula. However, anecdotal evidence suggested that *Set*®, in particular, encouraged the development of a multifaceted and complex mental phenomenon requiring the mastery and integration of four basic thinking skills—comparing, classifying, sequencing, and predicting. These basic skills contain subsets including decision-making, problem solving, drawing conclusions, and analyzing, all part of strategic thinking, which are central to a student's academic success Further, students not only need to learn to decode, recode, and organize information; they need to be able to analyze, interpret, and apply knowledge to both academics and the outside world. My experiences indicate that direct instruction in metacognitive awareness and strategic thinking increased academic proficiency. Developing and introducing a metacognitive curriculum that integrates strategic thinking skills into play has been the primary goal of this study. I chose to use exploratory and qualitative model that asked the following question: What are the effects, if any, of using a curriculum using *Set: A Family Game of Visual Perception*®. The instruction included explicit strategies for teaching and accessing the participants' metacognitive and strategic thinking. However, the study had some unexpected results and suggested further areas for study including executive function, sex and age based learning differences, processing speed, attention-deficit disorder, dyslexia, and social interactions. Finally, additional research regarding using *Set*® as a diagnostic tool might be pursued.

Executive Functioning An individual's executive functioning influences his ability to process and use information efficiently. A central component involves holding information in the working memory and organizing it into a coherent form. In *Set*®, a disorganized array interferes with a player's capacity to locate and identify sets. The disorganized array affected organization, self-regulation, and self-awareness. For instance, participants Evan and Blaine initially laid too

many cards in the array. This created visual confusion by introducing too many variables, which reduced the probability of identifying a set. As the creators of *Set: A Family Game of Visual Perception*® determined, the mathematical probabilities of finding set decreased as the number of cards in the grid increased (Falco 2001). Intervention helped the boys to recognize that too many cards interfered with applying strategies needed to identify sets. Once they began using the appropriate grid layout, their skills improved as did their interest and enjoyment of the game. Further, both boys became more self-confident and began to recognize and verbalize their strategies more clearly. A more in-depth analysis can be found in the individual case studies. Additional investigation into using strategy games as part of remediation of executive functions disorders may be appropriate.

Sex-Based Differences Sex-based differences occurred in the course of the study. During the sorting phase of the intervention, the three girls cooperated in determining the sorting categories. First, they discussed possible criteria for sorting. After selecting color as the first determinant, they divided the cards evenly by color and formed orderly piles based on their initial sorting criteria. They collectively refined the stacks first by shapes, then symbol fillings, and finally number of symbols. When asked what they thought might constitute a set, they discussed this amongst themselves and were able to successfully demonstrate and explain their hypothesis. This self-sufficiency continued throughout the study. The three male participants, on the other hand, randomly divided their cards into three stacks and each devised his own criteria. Lincoln chose to separate himself from Evan and Blaine because he disagreed with them and was unable to articulate his technique. When asked to integrate their cards, they argued about whose method would prevail. Finally, they spread all the cards on the floor in what appeared to be a random pattern. Photographs of the first card arrays are part of the record. During play, the boys often

squabbled about what constituted a set, who spotted it first, and the number of cards present in the card grid. As a result, they often requested mediation. In addition, the two of the boys, Evan and Blaine, began to create new card games using the *Set*® deck. The female participants, on the other hand, acted more independently. When disputes arose in both Phases One and Two of the activity, they would refer to the rule sheet and discuss what elements were needed to create a set. Intervention by the researcher was seldom needed or requested. A more detailed discussion of sex-based competitive behavior can be found in the section on interpersonal dynamics. These behaviors are consistent with pre-study trials with seventh and eighth grade students.[7] Additional study into sex-based decision-making and conflict resolution using games such as *Set*® may be beneficial.

Age-Based Difference. Participant age may have affected their abilities to articulate their metacognitive strategies both in verbal and written form. When compared with the seventh and eighth graders in the pre-study trial, the researcher noticed that the older students needed less direction in assessing and verbalizing their metacognitive strategies. During the formal study, I found that articulating strategic thinking skills proved more difficult for the participants if done independently. As a result, I promoted verbalization of strategic thinking skills by asking clarifying questions about the participants' strategies while they were actively engaged in play. I also encouraged exploring alternative processes both individually and as a group. However, the three male participants required more active intervention. I employed the same methods with participants' journal responses. Both boys and girls required this type of assistance. Some of these interactions are included in the audio recordings. The differences between the sixth graders and the seventh and eighth grader may due to the cognitive shift from concrete to

[7] I conducted pre-study trials in 2010 with students entering seventh grade and eighth graders during a study skills class at the same school site. I also use *Set*® in my private practice for diagnosis and remediation.

abstract thinkers that begins with puberty. However, it was not within the scope of this limited study to pursue this path. A comparative study of different age groups might be beneficial.

Processing Speed Playing *Set*®, competitively requires good visual acuity and fast reaction time. I noticed that as participants became more proficient, their processing speed increased. This was particularly true with Rowena who needed time to integrate the rules of the game and strategies. I also found that participants who had slower speeds benefitted from learning to play the game either by themselves or with a more proficient player. The proficient player, in turn, learned to articulate his or her strategies to the slower player. Anecdotal evidence from my practice supports these conclusions and I often use the game for remediation. Finally, *Set*® may be used as an informal assessment tool for processing speed. Discussion of *Set*® as a diagnostic tool can be found later in this paper.

Attention-Deficit Disorder I found that individuals with this disorder frequently do not have a comprehensive system for planning, organizing, rehearsing, recalling information, and monitoring their performance. In short, they lack thinking strategies that might reduce frustration and increase success. Lincoln, a study participant, had been diagnosed with ADD, the inattentive type. Lincoln found that playing *Set*® increased his ability to stay focused for longer periods. This is consistent with what I found in pre-study test group and in my practice. Evan, who did not have a formal diagnosis at the beginning of the study, also exhibited symptoms of ADHD. He could not sustain focus long enough to become proficient and became easily frustrated. Because many individuals with ADHD also have some executive functioning problems, playing the game may aid in developing better organizational and working memory skills for this boy. However, the length of the study was inadequate for specific remediation. Further discussion of both boys can be found in the study results. The evidence is antidotal;

consequently, future studies into the application of this study's protocols may be helpful in developing remediation strategies for these learning disorders.

Interpersonal Set® is an interactive game requiring cooperation among the players during the learning phase when participants need to communicate effectively. They learn to share knowledge, monitor play, and analyze information. When they begin to play competitively, it is essential that they behave with civility towards one another. The boys, in particular, may learn appropriate interactions from structured play. For instance, when Blaine and Evan began roughhousing during play, Joelle asked them to settle down. In the case of Lincoln, the study participant who was isolated from his peers and considered odd, the game gave him a structured way in which to interact with his classmates. In this context, fellow participants accepted him into the group and would often request him as a partner. More detail about this participant can be found in the study results. Finally, Joelle, who tended to be bossy, learned to be more considerate and willing to listen to other participants' suggestions and input. As she said, "I'm getting better at cooperating even when I want to win (audio recording)."

Competition plays an important role in most games and *Set*® is no exception. However, even here, the boys and girls differed in execution. Joelle and Melinda were fierce competitors with each other and the shouts of "Set!" filled the room when they played together. When one disputed a set, they stopped playing and analyzed the disputed cards. More often than not, they used this opportunity to refine their skills by deciding what cards were needed to correct the error. After coming to an agreement, they returned to the game with renewed vigor. Additionally, both girls selected partners with whom they were evenly matched. Consequently, they chose Blaine and Lincoln as partners rather than Evan. The boys, on the other hand, settled disagreements by yelling at one another. Even quiet Lincoln engaged in angry accusations

claiming that, "Blaine cheats and steals cards!" (student journal). During one dispute, Evan swept the cards to the ground and refused to continue to play. Interestingly, the behavior desisted when Blaine and Lincoln were playing with the girls. Instead, they adopted the more civilized approach. Evan, on the other hand, refused to compete with Joelle, Melinda, and Rowena.

Diagnostic Although it was not the intent, the study suggested that *Set*® might be an effective informal diagnostic tool for learning disorders such as executive function, processing speed, attention-deficit disorder, and visual acuity. My experiences indicate that games like *Set*® may be helpful with informal assessments, which are designed to assess a student's ability to master several items within a narrow band of skills. They may use direct measurements that track progress using instructional materials. I suggest a less traditional means of assessment by using *Set*®, to assess a student's processing speed, visual acuity, executive functioning, and learning modalities through task analysis that breaks a task to the smallest components. For instance, during the study, I observed that Evan appeared to be challenged with basic organizational skills. In addition, he became easily frustrated because he could not locate sets as quickly as the other participants could. I guessed that he might have both executive functioning challenges and issues with processing speed. Subsequently, he was formally assessed and the results confirmed that he had executive function disorder, was a slow processor, and had attention deficit disorder. Further studies regarding the accuracy of this type of use would be beneficial to educators who want a simple informal tool prior to assessment that is more formal.

Recommendations

This study examined the feasibility of using a game to develop metacognitive awareness and build strategic thinking skills. The intervention was exploratory and limited by time and the

number of participants. However, the results of the study indicate that students may be able to enhance their strategic thinking through directed play of non-computerized strategy games. As a result, middle-school students may become aware of how their ability to comprehend tasks and make judgments about possible outcomes affects their ability to more fully understand and internalize knowledge. Joseph states that, "studies of adolescent learning behavior describe that metacognitive behavior can be taught, resulting in practical skills to use throughout their lives" (Joseph, 2006, p. 34). I suggest that the development of a curriculum that integrates several non-computer strategy games into the entire school year may produce more discernible results. In order for students to build metacognitive awareness, teachers may construct an educational experience using specific metacognitive frameworks from which creative, thoughtful, engaged and strategic learners emerge. Because of individual differences, one game may not adequate for producing the desired effects. The games may include, but not be limited to, chess, checkers, *Go*®, *Set*®, card games that require planning, backgammon, *Risk*®, and *Battleship*®. To this end, teachers may modify any games that require strategic thinking skills to meet the needs of any classroom. Finally, although computer-based strategy games can be effective, they do not require social interactions or invite players to share strategies with one another. This may limit a student's metacognitive awareness and self-reflection. Incorporating strategy games into the middle school curriculum to enhance metacognitive reasoning is not the only use.

My study began with a simple premise that educators can promote strategic thinking skills in middle-school using *Set* ® *The Family Game of Visual Perception.* As I pursued my study, I discovered that the game had far more applications that needed to be explored.. I propose that *Set*® may be used as one of the informal screening tools for learning disabilities such as executive function disorder and processing speed. I also suggest that the game can be

part of a remediation strategy for these disorders as well as for visual processing and attention-deficit disorder as students who face these challenges may respond more positively to a playful approach to learning. Currently, most of my evidence is anecdotal and this study has been the first step in exploring the feasibility of using *Set* ® as an educational and remedial tool. In addition, my observations of boys and girls engaged in non-computer game play suggest that additional examination in this area may provide more information on sex-based cognitive differences. Finally, further studies regarding games as a means of addressing social deficits may be appropriate. Continued study in this area may mitigate social isolation and maladjustment. Games are a part of our lives and as educators, our responsibility requires that we examine how games can be integrated into the classroom, a private educational therapy practice, and the home as a teaching tool.

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Appendix A

From: Bree Popp [mailto:bpopp@setgame.com]
Sent: Monday, November 03, 2008 11:37 AM
To: writeon50@sbcglobal.net
Cc: 'cfalco'; 'Marsha Falco'
Subject: RE: Dr. Bob Falco-Permission to use Set for research

Sylvia,

Your thesis topic sounds very interesting and we are delighted that you have chosen to use SET® as the center of your project. You have our permission to use our trademarked and copyrighted material in your thesis, provided that you include the following copyright and trademark information: Copyright ©1988, 1991 Cannei, LLC. SET® is a registered trademark of Cannei, LLC.

We would love to have a copy of your paper once your research is complete.

Regards,

Bree Popp
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(480) 837-5644 – fax
bpopp@setgame.com
www.setgame.com

Appendix B

Dear Parents,

Your child has chosen to be one of six students to participate in an exploratory feasibility study about the effect, if any, of non-computer strategy games on building strategic thinking skills, an integral component in student's academic success.

This study is part of my master's thesis in education from Holy Names University. The results will not be used for any other purpose and the anonymity of the participants and the school will be protected through pseudonyms. The study participants will be instructed in playing the strategic card game, *Set: A Family Game of Visual Perception*®. The purpose is to evaluate whether strategy games such as *Set*® can have any impact on building strategic thinking skills. Skills associated with *Set*® include abstract reasoning, memory, organization, and strategy development, all required in academic endeavors.

The students will meet twice weekly for eight weeks for a total of sixteen sessions. The study will take place during 2010 winter semester in the twice-weekly activities period and be supervised by the researcher. Because of the time limitations, students who participant will need to commit to attending all sixteen sessions. The participants will keep a journal and complete short pre-and post-instruction questionnaire. These will be compared to my research observations. Your child may benefit from his or her participation as he or she acquires better strategic thinking skills that might transfer to classroom endeavors.

Please complete and sign the attached "Consent for Participation and Release of Information Form" and return it to your child's homeroom teacher by December 12, 2010. A summary of the results of the study will be available by June 2011.

Should you have further questions or require additional information, please contact me at 510-610-8910 or email me at writeon50@sbcglobal.net. I will be happy to provide a copy of my proposal at your request.

Thank you for permitting your child to participate in my study.
Sincerely,

Silvia J. Sykes
Educational Therapist

Candidate Master's in Education
Holy Names University
Oakland, CA

Appendix B

Consent for Participation and Release of Information

I/we _____grant permission for our child,

_____to participate in the strategic skills study using Set*: A Family Game of Visual Perception*® with Silvia Sykes, a candidate for a Master's in Education from Holy Names University.

Please initial:

_____We understand that Ms. Sykes may photograph parts of the study and that our child's face will not be included in those pictures.

_____We also understand that Ms. Sykes will be producing an audio tape of the discussion groups and that the tapes are confidential.

_____We understand that the sole purpose of the study is to provide information for a master's thesis from Holy Names University in Oakland, California.

_____We have read the attached explanation of the study and understand its purpose and design.

_____Date_____

Parent/Guardian

_____Date_____

Silvia Sykes
Candidate for Master's in Education
Holy Names University
Appendix C

Dear Ms. Swainson,

Thank you for considering my request to include six to eight of your sixth and seventh-grade students in my study. The results will be used in my master's thesis in education from Holy Names University. The results will not be used for any other purpose. The privacy of the participants and the school will be protected through use of number codes and pseudonyms. The study uses the card game, *Set: A Family Game of Visual Perception*® to determine whether strategy games such as *Set*® can enhance middle school students' strategic thinking skills. These include:

- Abstract or meta reasoning through strategy development and card set sorting
- Working and long-term memory by holding types of sets in memory
- Organizational skills used to sort the cards based on symbols, numbers, colors, and shadings

The students will meet with me twice weekly for eight weeks for a total of sixteen sessions during the winter activities period. Students will be asked to complete short pre-and post-intervention questionnaires as well as a journal consisting of closed and open-ended questions.

I am including a copy of my proposal for your perusal. Should you have further questions or require additional information, please contact me at 510-638-8915 or email me at writeon50@sbcglobal.net.

Thank you for permitting your students to participate in my study.

Sincerely,

Silvia J. Sykes

Candidate Master's in Education
Holy Names University
Oakland, CA

I give Silvia Sykes permission to conduct a study for her master's thesis at The Head Royce School in Oakland California. I understand that the study will be used only for the purpose of Ms. Sykes master's thesis.

Signed_____Date_____

Carol Swainson, Head Royce School Head Master

Appendix D

Student Profile

Participant Number_____

Date of Birth_____

ChronologicalAge_____Grade_____

Consent Signed by_____Relationship_____Date_____

Homeroom Teacher_____

1. Does the participant have any diagnosed learning disabilities? ____Yes ____No
2. If yes, what is the learning disability?
3. When was the assessment done?
4. Does the participant have observable learning challenges not identified through professional assessment?
5. If yes, what has been observed?

6. Were these observations made by:

   ____Teacher ____Parent ___Educational Specialist _____Other: Please specify.

7. Is the student currently receiving educational support services from:

   ____Tutor ____Educational Therapist ____School Resource Teacher _____Other: Please specify

8. If yes, for what reason?

Appendix E

Participant's Name_____ Number Code_____

Date_____

Pre-Instruction Student Questionnaire

Learning strategies are ways for you to think about planning, organizing, remembering, and understanding information. They help you to think about how you think. Please answer the following question.

1. I have played the following games:

   ___Checkers ___Chess ___Go ___Mastermind ____Battleship ____Other strategy games

2. If you play other non-computer strategy games, what are they? _____

3. I know what learning strategies are. ____Yes ____No

4. I understand how I learn best. ____Yes ____No

5. I learn best when I:

   ____Visualize or see what I need to learn ____Hear what I need to learn

   ____Touch or manipulate objects____Engage in physical activity or movement

6. I think about how I think and learn.

   ____Never ____Rarely ____Sometimes ____Often ____Always

7. I use learning strategies to help me learn:

   ____Never ____Rarely ____Sometimes ____Often ____Always

8. I currently use learning strategies for:

   ____Math ____Reading ____Social Studies ____Science _____Writing

9. Give an example of a learning strategy that you might use in school._____

   _____

Thanks for participating in my study. I hope that you have fun!

Appendix F

Participant's Name_____ Number Code_____

Date_____

Post-Instruction Participant Questionnaire

Please answer the following questions. Use the back of the paper if you need more room. You may refer to your Participant Journals.

1. I am able to explain all the rules to other students. ____Yes ____No
2. I am able to describe my *Set*® playing strategies to others. ____Yes ____No
3. I am a better strategic thinker because of learning *Set*®. ____Yes ____No
4. My *Set*® strategies changed as I learned the game. ____Yes ____No
5. Two of the strategies that I used successfully are:
   a.
   b. _____
   _____
6. How did your strategies change? Give an example_____
   _____
   _____ _
7. Will you continue to play the game? Why or why not? _____
   _____
   _____
8. Do you have any other comments about learning to play *Set*®*?* _____
   _____
   _____
   _____
   _____

Thank you for taking the time to participate in this study. Your help has been invaluable!

Appendix G

Participant's Name_____ Number Code_____

Date of Entry_____

Participant Journal

Take a few moments to reflect on your experiences today. You may use your journal entries to guide discussion at the end of each session.

1. When looking for sets, what do you look for first?

   ____Colors ____Number of Symbols ____Types of Shapes ____Types of Fillings

2. Which types of sets are easiest for you to find?

   ____More similarities (same colors, shapes, fillings, and number)

   ____More differences (different colors, shapes, fillings, and number)

3. Discussing *Set*® with other players helps me to understand the game. ____Yes ____No

4. I currently rate myself as a ____Beginner ____Good ____Proficient ____ Master

5. I am becoming a better *Set*® player. ____Yes ____No

6. I am becoming a better strategic thinker. ____Yes ____No

7. I am using more strategic thinking skills in the classroom.

   ____Never ____Rarely ____Sometimes ____Often ____Always

Notes on strategies:

Appendix H

Researcher's Weekly Observation Log

Participant Name_____Date_____

1. The participant is able to explain a strategy that he or she might be using. ____Yes____No

2. Description of strategy.

3. The participant shares strategies with other participants. ____Yes ____No

4. The participant is integrating new strategies. ____Yes ____No

5. The participant asked researcher or other participants for help ____Yes ____No

6. The participant participates in focus group discussions. ____Yes ____No

7. Participant's overall demeanor:

   _____Eager ____Engaged____Anxious ____Frustrated ____Angry ___Other

Other observations:

Appendix I

SET RULES

1. SHUFFLE THE CARDS THREE TIMES
2. LAY 12 CARDS OUT FACE-UP IN A RECTANGULAR GRID
3. LOOK FOR A SET. BELOW ARE SOME EXAMPLES:

*All three cards are **red**; all are **ovals**; all have **two symbols**; and all have different **shadings**.*

*All have different **colors**; all have different **symbols**; all have different **numbers of symbols**; and all have the same **shading**.*

*All have different **colors**; all have different **symbols**; all have different **numbers of symbols**, and all have different **shadings**.*

4. IF THERE IS A SET, CALL OUT "SET." THE OTHER PLAYERS DECIDE IF IT IS A SET.
5. IF THERE ARE NO SETS, LAY OUT 3 MORE CARDS
6. THE GAME ENDS WHEN ALL THE CARDS HAVE BEEN USED AND NO MORE SETS REMAIN. COUNT THE NUMBER OF SETS OF EACH PLAYER. THE ONE WITH THE MOST SETS WINS.

Appendix J

Session Overview

Focus Groups: Post-instruction self-talk is an important component of the MTF. Consequently, each session concludes with a focus group in which the participants engage in a conversation about the day's play. These discussions are open-ended and based upon entries in the participant journals. The purpose is to aid building and integrating strategic thinking skills as well as supporting metacognitive awareness. Because of the open-ended nature of the focus group, the primary purpose will be integration and comprehension of strategic thinking skills. The researcher may make an audio recording of the discussion for later analysis.

Sessions One: Pre-Instruction

- Participants fill out the pre-instruction questionnaire and share their responses with the other participants and the researcher.
- The researcher explains the purpose of the instruction and answers questions that the participants might have.
- The participant journal is introduced and the researcher explains that the purpose is to track changes in the participants' strategic thinking skills and to facilitate the focus group discussion at the end of each session.
- Participants are assigned partners. Each partnership will be given a deck of *Set*® cards, which they examine.
- The paired participants decide how to sort the cards--by color, number, or shading. The researcher may photograph the sorting strategies.
- The researcher asks each group to explain how they sorted their cards
- The participants study their cards and attempt to form sets without the researcher's input.

- Participants share what they believe is a set with the entire group
- Participants answer the first four questions in their participant journals.
- At the end of the exploration, the participants share their entries with the entire group.

Session Two—Researcher Modeled Training

- The researcher models set formation by asking the students to decide what card will be needed to complete a set. For example, if a player has cards with one solid red squiggle and one card with two striped green diamonds, the researcher asks the participants to select a card that would make a set from their decks.
- The process is repeated with different types of partial sets until the participants exhibit proficiency in forming sets.
- Talk Aloud instruction: The researcher lays out a grid and explains how she looks for sets. She may indicate that she looks scans the grid and then looks for similar attributes such as color, shape, shading, or number or that she selects one attribute and seeks cards that complete the set. The talk-aloud activity facilitates modeling her strategic thinking process.
- Participants may also suggest alternative strategies to the researcher.
- The *Set*® rule sheet is introduced and discussed.

Sessions Three through Six—Assisted Instruction

During the instruction phase, the play is not competitive and the players take turns looking for sets. The researcher circulates among the group and offers assistance and suggestions for finding sets as well as answering questions that the participants might have. She may also model strategies or ask players what additional type of card might constitute a set. As the players become more familiar with the game, the first player to identify a set calls out “Set.” If the other

players agree, the player who recognized the set takes the cards and replaces them with three more cards from the deck. If it is not a set, the participants evaluate what is needed to make a set. The researcher may mediate in disagreements between the players. The game ends when all the cards have been displayed and no more sets remain. The researcher begins the session with the following steps:

- Each participant pair is given the *Set*® rule sheet and a deck of cards.
- The researcher models laying out the grid of twelve cards. She explains that cards are laid out in multiples of three and asks why this is done.
- Review the rules and answer questions.
- At the conclusion of the pre-play instruction, each pair performs the following operations:
  - ✓ Lay out 12 cards in a rectangular grid of 3 x 4 cards.
  - ✓ Study the cards and look for sets of three cards.
  - ✓ If there are no sets, participants will discuss what cards would be needed to form a set.
  - ✓ Add more cards in multiples of three if a set is found
  - ✓ Add more cards in multiples of three if no set is found
- Participants write in their journals answering all of the questions and noting the following:
  - ✓ What strategies they used to find the sets,
  - ✓ what they might do differently
  - ✓ what types of sets were easier for them to see
  - ✓ Note what was easy and what was frustrating.

- Focus Group: The journal observations will be used to generate discussion during the focus group at the end of each session.

Sessions Seven through Fifteen—Independent Play

During this phase, the researcher observes the play but does not actively participate. The goal of sessions seven through fifteen become more proficient and move towards mastery of the game. Play may be either cooperative or competitive.

- First day of each week will be devoted to paired play. Partnerships will change at the beginning of each week.
- Second day of each week, participants will divide into two quartets
- Participants lay out the playing grid and begin identifying sets. They may choose to play competitively or cooperatively. During competitive play, each player tries to accumulate the most sets. If they choose to play cooperatively, they may assist each other in finding sets by giving clues or making suggestions
- Participants play as many games as they can during the session and note the number in their journals.
- At the end of each session, the participants write in their journals
- The researcher leads participants in sharing their entries with the entire group.

Session Sixteen: Post Instruction Assessment

- Participants complete the post-instruction student questionnaire, compare it to pre-instruction questionnaires, and note any changes that they have observed.
- The researcher shares her observations based on the researcher's journal and process journal

- . Participants engage in a final focus group to evaluate their perceptions of their strategic thinking skills. The post-instruction questionnaire will provide the primary framework for the discussion.
- Discussion questions may include:
  - ✓ whether or not they believe the instruction has affected their classroom performance
  - ✓ Helped to improve grades, and encouraged them to think strategically in the classroom.
  - ✓ Participants will be encouraged to provide their own open-ended questions or observations as well.

Appendix K

Overview of *Set: The Family Game of Visual Perception®*

Activity: *Set: The Family Game of Visual Perception®* (Set Enterprises, Inc., Fountain Hills, AZ, 1991) The purpose of the game is to identify a set of three cards. Each card has four variable features:

- Symbols—One of the following: ovals, squiggles, or diamonds
- Colors—Symbols are either red, green, or purple
- Number—Each card has one, two, or three symbols
- Shading—Symbols are either solid color, striped, or outlined with one of three colors

Objectives: *Set™* supports development strategic thinking skills by using a concrete cognitive activity. The game teaches and reinforces:

- Abstract or meta reasoning—strategy development through card set sorting
- Working and long-term memory—holding types of set in memory, learning rules
- Organizational skills—sorting by symbols, numbers, colors, and shadings
- Visual tracking—finding sets within the grid
- Social pragmatics such as turn taking, social interactions, and learning to read body language.
- Expressive language and receptive language—discussion of sets, learning rules
- Decrease cognitive processing time as set recognition abilities increase
- Metacognition—student evaluation of strategies

Age Group: The activity is most effective with adolescents. However, children as young as six can benefit from the sorting aspect of the game

Materials:

- One *Set™* card game—concrete and hands-on
- Poster of shapes, colors, numbers, and shadings—stable stimuli for memory reinforcement
- Rule Sheet—retrieval of permanent or intransient information for problem solving strategies

Pre-Activity:

- Examine the cards and compare them to the poster of shapes, colors, numbers, and shadings.
- Sort them first by color, then numbers, and finally shadings.
- Discuss what constitutes a set
- Practice creating different types of sets

Play: The game can be played with one, two, three, or four participants

- Lay out 12 cards in a rectangle grid.
- Players study the cards and look for sets of three cards.
- If there are no sets, add more cards in multiples of three.
- During the first few games, have the players take turns.
- As the players become more familiar with the game, the first player to see a set calls out, “Set.”
- If the other players agree, the player takes the cards and replaces them with three more cards.
- If it is not a set, evaluate what would be needed to make a set.
- The game ends when all the cards have been laid out and no more sets remain

Alternate Activity: Develop memory skills by giving the student 2 to 4 sorting instructions. These can vary according to the student’s abilities to hold information in memory. Model the activity. Ask the student to spend a couple of minutes to strategize. This activity can be timed or untimed. Some combinations may include:

- Sorting by color and number. Example: Sort all of the reds with one symbol
- Sorting by color, number, and shape. Example: Sort by color, all the same number of symbols, and by shape
- Sorting by filling, number, and color. Example: Separate by filling. Then sort by number and color
- Sorting by number, color, and/or filling. Example: Create piles by color, then sort again into piles that have one of each number. Sort those piles based on the type of filling

Appendix L

HOLY NAMES UNIRESEARCH PROTOCAL

DESCRIPTION OF STUDY

All researchers/investigators (faculty and students) must obtain prior approval to conduct research with human subjects. This application is to be submitted to and approved in writing by the Holy Names University IRB Committee prior to the initiation of any investigation involving human subjects, data, or material

Date Received: _____	**Date Returned for Revisions_____**
Date Reviewed: _____	**Approval Date: _____**
Names and Signatures of Proposal Approval:	
_____ _____	**_____**
Charles Ahern, PhD Marion Marshall, M.S.	**Zaida McCall-Perez, Ed.D**
Lead/Adviser Reader #2	Reader #3

A. Principal Investigator: Name Silvia Sykes

Department: Graduate Education **Program Master's** of Education/Certificate in Educational Therapy

Research Question(s): What are the effects, if any, of a curriculum using *Set: A Family Game of Visual Perception®* on strategic thinking skills in middle school students?

B. Is extramural funding being sought? No

LOCATION OF STUDY: Holy Names University, 3500 Mountain Blvd, Oakland, CA 94619

RESEARCH SITE: The Head Royce School, 4325 Lincoln Avenue, Oakland, California

The Head Royce School is an independent k-12, co-educational school. I currently work at the school as a substitute teacher, primarily in the middle school. The study will be conducted in school classroom.

DATE OF STUDY: Winter semester, 2010-2011

PARTICIPANTS:
Eight-sixth and seventh grade students who meet the following criteria: participant can have no prior experience with the game, *Set: A Family Game of Visual Perception®,* and able to commit to two weekly, 50-minute sessions for a period of 8 weeks. Participants may have a diagnosed learning disability. Participants will be evenly divided between boys and girls. The participants will select the study as part

of a bi-weekly strategic games activity. Participants need to enjoy playing games and be voluntary participants. The participants must have an excellent attendance record with no absences in a two-month period. They must be willing to commit to the sixteen sessions required for the study. Participants may have one absence during sessions three through fifteen.

PURPOSE AND POTENTIAL BENEFITS:

The purpose of the study is to determine whether strategy games such as *Set®* support development of strategic thinking skills through direct training. The potential benefits include transfer of *Set®* skills to other academic areas and improvement in overall strategic thinking skills. The study may also inform classroom practices in all academic areas.

METHODS AND PROCEDURES:

The study is an exploratory, qualitative feasibility design with one group of eight participants equally divided between boys and girls. Participants will meet with the researcher twice weekly for fifty minutes sessions for eight weeks for sixteen sessions. The instruction is divided into three segments: (a) pre-intervention assessment, (b) training, and (c) post-intervention assessment. The study uses the Metacognitive Teaching Framework (MTF), which has three basic components—researcher modeling and instruction, researcher/participant interactive instruction, and independent participant play. The participants will learn to play *Set®* during these sessions and write in a student-generated journal. In addition, the investigator will keep an observation log during the sessions. Participants will complete pre-and post-instruction questionnaires.

PARTICIPANTS PAYMENT OR COSTS:

None

SUBJECT CONFIDENTIALITY:

All names and identifying information will be kept confidential throughout the study. Participants will be assigned a numbered code at the beginning of the study. This number will be used for the participant profile, pre-and post-instruction questionnaires, and journals. Pseudonyms will be used to protect the anonymity of the participants and the school in the written discussion.

POTENTIAL RISK TO SUBJECTS:

There is no potential risk for the participants during the study. However, participants may request that their parents purchase the game for home use.

Declaration of Research Question, Design, and Committee

Date: __November 26, 2010_____

Name: (last) ___Sykes_____ (first)__Silvia_____(initial) ___J___

Email: __writeon50@sbcglobal.net_____Phone: 510-638-9815_____

Mailing Address: _580 Elysian Fields Drive, Oakland, California 94605_____

Topic of my study will be:

Promoting Strategic Thinking in Middle School Students Using *Set: The Family Game of Visual Perception®.*

My approved Research Question is:

What are the effects, if any, of a curriculum using *Set: The Family Game of Visual Perception®* on strategic thinking skills in middle school students?

My Research Design/Methodology is: Qualitative exploratory feasibility design

My Lead Adviser is: Charles Ahern, PhD

My Committee Members are:

Marion Marshall, M.A., BCET

Zaida McCall-Perez, Ed.D

Intended date of completion: March 2011

Signature: _____ Date: _____