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UTILIZING A SELF-QUESTIONING STRATEGY DESIGNED WITHIN A SELF-REGULATED STRATEGY DEVELOPMENT INSTRUCTIONAL APPROACH TO PROMOTE IDEA GENERATION IN STUDENTS WITH LEARNING DISABILITIES

A Dissertation in
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by

Raol J. Taft

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The dissertation of Raol J. Taft was reviewed and approved* by the following:

Linda H. Mason  
Associate Professor of Special Education  
Dissertation Advisor  
Chair of Committee

Thomas Farmer  
Associate Professor of Special Education

Pricilla K. Murphy  
Professor of Educational Psychology

Kathy L. Ruhl  
Professor of Special Education  
Head of the Department of Educational and School Psychology and Special Education

Mark Greenberg  
Professor of Human Development and Psychology

*Signatures are on file in the Graduate School
ABSTRACT

Students with learning disabilities (LD) often have problems generating ideas across academic areas. A single subject multiple baseline across participants study was used to investigate an idea generation intervention for improving performance of three 7th grade students with LD. Students were taught within a self-regulated strategy development (SRSD) instructional approach to use a researcher designed idea generation self-questioning strategy, RAN (Review key words and phrases, Ask What-How, Who-How questions, Notes-Now add notes). Idea lists generated by students after instruction indicated that two students received benefit from RAN strategy instruction and improved their ideational fluency. However, results for one student indicated no benefit from RAN instruction. This study provides preliminary evidence that students with LD who have difficulty generating content or ideas may benefit from strategy instruction for idea generation. Implications for future research are discussed.
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CHAPTER 1
INTRODUCTION

In many contexts, idea generation (ideation) is important. New ideas can be the basis for innovations in organizations and industry (Coskun, Brown, Paulus, & Sherwood, 2000). For companies and businesses, for example, idea generation is a vital component for developing new products and techniques to advertise those products (Coskun, 2005; Toubia, 2006). The ability to generate new ideas for content and problem solving is also regarded as crucial in many academic domains including writing, mathematics, and reading (Graham & Harris, 2003; Passolunghi & Siegel, 2004; Swanson & Siegel, 2003). Collectively, problems with long-term memory (LTM), working memory (WM), and metacognition pose a problem in idea generation.

Theoretical Approaches to the Study of Idea Generation

Information processing theory. Information processing theory compares the human mind and the way it stores and retrieves information to a computer in the way it stores and retrieves information. Information Processing Systems theory (IPS) states that human information processing is controlled by a system of rules and regulations (Newell & Simon, 1972). Generally, information is stored in a system of nodes, schemata, or frames. A stimulus initiates a cue to construct a retrieval probe to long term memory. Information selected by strength of association is brought back to WM where it is manipulated and used to construct new knowledge (ideas). This knowledge construction is restricted due to limited capacity of WM to store five to nine information units or symbols (Miller, 1956). LTM on the other hand, has unlimited capacity and is organized associatively.

Creative thinking. Creative thinking considers idea generation an active process involving active participation and divergent thinking by the individual. Divergent thinking is a
form of thinking used when the individual faces an open-ended problem and may need to produce numerous and diverse ideas (Runco, 2007). Individuals proficient in ideation are able to use divergent thinking, can produce numerous ideas (fluency), can switch idea categories easily (divergent thinking) and can produce useful, novel ideas (Runco).

**Idea Generation and Memory**

The ability to retrieve information from LTM, manipulate, and reorganize information in WM is vital to constructing new ideas (Baughman & Mumford, 1995). Research has shown that new ideas cannot be generated if prior knowledge cannot be retrieved from LTM and used to reconstruct that knowledge in WM (Baughman & Mumford; Mobley, Doares, & Mumford, 1992). Information retrieved from long term memory cannot contribute to new ideas or insights unless it is manipulated there must be some type of transformational process which reorganizes and combines information (Mobley, et al.; Runco & Chand, 1995). When there are deficits in working memory, integration of information retrieved from long term memory with other information is impeded and further cognitive processes are inhibited (Gathercole, Alloway, Willis, & Adams, 2006).

Swanson and Saez (2003) found that individuals with LD may be deficient in memory skills and thus face problems with a variety of academic and cognitive tasks. Working memory deficits in children with LD can reflect problems in the executive system and are primary contributors to difficulties in math, reading, and writing. These deficits place students with LD at a clear disadvantage when involved in activities requiring high demands on a limited capacity system such as WM (Swanson & Saez). Deficits in working memory impede integration of information retrieved from long term memory with other information and inhibit further cognitive processes. Gathercole et al. (2006) suggest that deficits in working memory promote
an information bottleneck in the system which hinders learning and impedes incremental knowledge acquisition.

**Memory and mathematics.** Passolunghi and Siegel (2004) found that children with LD had a generalized and persistent deficit in working memory. Passolunghi and Siegel suggested that working memory deficits in students with difficulties in mathematics might be related to an inability to reduce irrelevant information. In addition, some children with math disabilities have a persistent deficit in their ability to store or retrieve number combinations from long term memory. This may be related to a deficit in the ability to retrieve facts from semantic long-term memory (Geary, 2000) or an inability to inhibit retrieval of irrelevant information (Jordan, Hanich, & Kaplan, 2003).

**Memory and reading.** Siegel (2006) found individuals with a reading disability exhibited deficits in short term memory and working memory. Schuchardt, Maehler, and Hasselhorn (2008) found that specific reading disorders were due to a disorder in the phonological subsystem of WM rather than a deficit in the central executive functioning (Baddeley, 1992).

**Memory and writing.** It is well known in the literature that students with learning disabilities (LD) have difficulties with writing (Harris, Graham, Mason, & Friedlander, 2008). Of particular concern are apparent deficiencies or deficits in memory retrieval and manipulation of information. Searching and integrating knowledge is a critical skill in writing (Williams, 2003). Poor writers have difficulty generating subordinate ideas or categories of related information (Swanson, 1987). Students with LD are less able to employ strategies to help them sustain memory searches (Englert & Raphael, 1988). Englert and Raphael noted that students with LD had difficulty producing multiple statements about topics and that many students, when
prompted, had much more knowledge about a topic than their written compositions demonstrated. This indicated a problem with “retrieval and use of relevant schemas from memory that might sustain their thinking and writing in a generative way” (Englert & Raphael, p. 514). These researchers concluded that memory searches of students with LD were not effective in retrieving all of the information these students had in memory. Further, this suggests that these students lacked an ability to activate and sustain memory searches and that they had difficulty activating new or deeper knowledge searches. As stated previously, memory deficits can affect performance in idea generation.

In addition to difficulties with knowledge integration, children with LD typically use a knowledge telling approach (Scardamalia & Bereiter, 1987) to writing as compared to a knowledge transforming approach. Knowledge telling is a convergent think-say process of composing that continues until the search results in depletion of ideas. Students with LD typically spend less time planning and have difficulties generating ideas and editing compositions, and produce compositions of shorter length with more mechanical errors than their non-disabled peers (Graham & Harris, 1996). The knowledge-transforming model employed by more mature writers is a more thorough search of memory which results in increased idea or content generation and better compositions (Scardamalia & Bereiter).

**Metacognition.** It is well known in the literature that students with disabilities have deficits in metacognitive skills (Englert & Marriage, 2003; Graham & Harris, 2003; Wong, Harris, Graham, & Butler, 2003). Gersten, Fuchs, William, and Baker (2001) state that although students with LD possess the cognitive tools essential for processing information, for some reason they do not effectively process it. These researchers suggest that students with LD experience breakdowns in strategic processing and metacognition. Lack of metacognitive skills
has been shown to hamper idea generation (Englert, Raphael, Fear, & Anderson, 1988).

**Promoting Idea Generation**

Research has shown that deficiencies in LTM, WM, and information reorganization and manipulation can act as a constraint on idea generation (Englert & Raphael, 1988; Swanson, 1987; Williams, 2003). Research suggests there might be several ways to promote idea generation. The fact that students with LD cannot sustain memory searches would suggest that memory searches might be shallow (Finke, Ward, & Smith, 1992). Promoting deeper and more flexible memory searches of semantic categories in LTM should result in more ideas from a category and searches of more semantic categories (Rietzschel, Nijstad & Stroebe, 2007).

Research also indicates a need to teach metacognitive skills to students so they can apply newly learned strategies (Graham & Harris, 2003; Harris et al, 2008; Mason & Shriner, 2009).

**Cognitive Strategy Instruction**

One empirically validated approach for improving metacognitive strategies is Self-Regulated Strategy Development (SRSD: Harris & Graham, 1986). SRSD provides teachers an effective, flexible instructional approach which can be adopted to address the needs of a diverse group of students with special needs. SRSD has proven effective in teaching content relevant metacognitive skills to students across a variety of content areas including mathematics, reading, and writing (Graham & Harris, 2003). SRSD is the instructional approach selected for the proposed study.

**Purpose of the Study**

According to Swanson and Saez (2003) children with LD do not utilize their true memory skills and abilities. These researchers suggest that instructional procedures should attempt to tap these unused abilities. The purpose of the proposed study was to develop and evaluate the effect
of an idea generation strategy designed to promote deeper memory searches by teaching students to extend memory searches. Students were taught metacognitive skills in a manner that would promote skill acquisition and strategy use. The effect of idea generation strategy instruction on idea generation performance of students with LD was measured by changes in ideational fluency. The foundational underpinning of the intervention drew from research in information processing, creative thinking, and SRSD research. Specifically, this study addressed the following four questions related to idea generation and students with LD:

(1) Does SRSD instruction for idea generation improve idea generation fluency performance of students with LD?

(2) What are the origins of generated ideas by strategy stage?

(3) Will participants report that the strategy and instruction help with idea generation?
CHAPTER 2

REVIEW OF THE LITERATURE

Students with disabilities often have difficulty generating ideas and content for written composition and problem solving across a variety of academic domains. These difficulties can be linked to deficits or deficiencies related to memory processes and lack of metacognitive abilities. A review of studies (Swanson & Saez, 2003) revealed that students with learning disabilities (LD) had difficulties in executive processing relative to encoding of information, use of retrieval strategies, and switching attention when manipulating information in working memory. These deficits are associated with problems related to information retrieval from long-term memory (LTM) (Baughman & Mumford, 1995) and information processing in working memory (WM) (McCutchen, 1996; McLean & Hitch, 1999; Swanson, 1987; Swanson & Ashbaker, 2000). More specifically, students have been found to have difficulties in working memory associated with the central executive, phonological loop, and visuo-spatial sketchpad (Baddeley, 1992; Gathercole, Pickering, Ambridge, & Wearing, 2004) and problems with knowledge manipulation and reorganization (Baughman & Mumford; Mobley, et al., 1992).

Problems with metacognitive skills have also been well documented in the literature. Kolligan and Sternberg (1987) found that students with LD employed deficient cognitive strategies and had deficient knowledge in certain domains. This resulted in problems with encoding, evaluating, and combining information in order to form new knowledge representations. Williams (2006) states that cognitive processing problems such as difficulties in working memory and ineffective self-monitoring can result in reading comprehension problems. Students with LD often have lack spontaneity, flexibility, planning, monitoring, and checking their work (Brown & Palincsar, 1982; Englert, et al., 1988).
In order to understand how individuals process information and how deficits in information processing can impact individuals with disabilities it is be helpful to examine the extensive literature in the areas of information processing and creativity. While it is beyond the scope of this review to provide an exhaustive examination of these areas, it is within the purview of this review to provide (a) a general review of how people store, retrieve, and process information, (b) a general description of the mental processes and characteristics of creative people, and (c) a discussion of how these processes relate to idea generation and students with disabilities. This review also discusses how idea generation is measured and will postulate an instructional strategy for facilitating idea generation.

The review begins with a brief definition of idea and idea generation followed by a general discussion of the human information processing system (IPS). Because there are many approaches to describing IPS, a chronological format will be utilized. IPS models which have been influential in the field are given a brief description starting with Atkinson and Shiffrin’s (1968) three stores model and ending with a more contemporary model proposed by Nijstad and Stroebe (2006).

The second section of the review consists of a general overview of creative thinking. Creative thinking and a creative idea are defined. Characteristics of creative people and mental processes used by creative individuals during ideation are discussed. How creative thinking impacts the ideation process and how creative thinking relates to generating new ideas is examined. The concept of ideational fluency and flexibility (divergent thinking) is discussed next. The second section concludes with an analysis of how creativity relates to individuals with LD.

The third section of the review consists of an examination of problems in academic
content areas, how deficiencies in information processing affect academic performance, and how these deficiencies relate to and impact idea generation performance of students with LD.

The fourth section of the review evaluates and summarizes the discussion of previous sections in terms of key variables which need to be addressed in the design of an idea generation strategy. This section discusses the importance of prior knowledge, memory searches, flexible thinking, and working memory and how these variables can act as constraints on idea generation.

The last section discusses strategy rationale, design, and basis for the decision to use a self-regulated strategy development (SRSD) instructional approach to teach idea generation. SRSD has been found to be effective across a variety of content areas including mathematics, reading, social studies, writing, and reading. These academic areas often present difficulties for students with LD. SRSD has been empirically validated in over 40 studies including 27 single-subject design studies (Harris, Graham, Brindle, & Sandmel, in press). SRSD, therefore, presents a potentially effective format for teaching an idea generation strategy to students with LD. The literature review concludes with an overview of the idea generation strategy and lessons.

While it is recognized that idea generation is a critical component for academic success, few studies have examined the difficulties that students with disabilities have in idea generation and the role that it may play in enhancing their ability to succeed in some content areas. The goal of this review is to explore the literature base on idea generation, to determine what is known about idea generation and related constructs in students with disabilities, to understand the ideational process of individuals proficient at generating ideas, and to use this information to generate a system of components that can be used to promote idea generation in students with disabilities.
Idea Generation

Definition of Idea and Idea Generation

In order to define idea generation it is imperative to first conceptualize what is meant by the term idea. According to the Concise Oxford American Dictionary (2006), an idea is “a thought or suggestion as to a possible course of action, a concept or mental impression, an opinion or belief, or a feeling that something is probable or possible.” An idea, then, can be defined as an element of thought that can be visual, concrete, or abstract which can be generated through a number of mechanisms including cognitive processes. Investigations of mechanisms involved in idea generation are found in the vast literatures of information processing theory and creative thinking.

Information Processing Theory

Theories of information processing generally have emphasized organization, storage, and retrieval of information or characteristics of memory decay over time. Generally, information processing theories propose a memory system of multiple components. Describing models that encompass all of the intricacies of knowledge processing in the human mind, however, is difficult. Walker and Kintsch (1985) state the following:

Models that adequately describe how people retrieve real-world knowledge are not yet available, however. One difficulty has been accounting for the complex control processes that appear to be involved in retrieval, and another is separating problems of knowledge use from those of retrieval itself. (p.261)

Atkinson and Shiffrin (1968)

One of the most influential models of working memory is the model proposed by Atkinson and Shiffrin (1968). The three stores model of information processing is composed of
three major components: the sensory register, long-term memory stores (LTS), and short-term memory stores (STS). The three stores model (Atkinson & Shiffrin, 1968, 1971; Shiffrin & Atkinson, 1969) places a major emphasis on the role of STS in the memory system and the control processes under the subject’s control. The first component of the three stores model, the sensory register, is responsible for receiving stimulus input and registering the information into the correct stimulus dimension. The second basic component of the model is the short-term store (STS). Atkinson and Shiffrin (1968) regard the STS as the individual’s working memory. Information is stored only briefly in STS and is subject to memory loss unless subject controlled rehearsal mechanisms maintain it in STS.

Long-term store (LTS) is the third component of the model proposed by these researchers (Atkinson & Shiffrin, 1968). While information in the sensory register and STS are eventually completely lost, information stored in LTS is relatively permanent. The LTS is a content addressable or self-addressing memory system where information is presented to the system and defined by any number of memory areas which dictates where the information will be stored. Information items with prominent characteristics are more easily identified in memory searches, while information items with less prominent characteristics are less likely to be located during memory searches unless more in-depth searches are conducted.

In the three stores model, the process of storing and retrieving information from long-term memory begins with an examination of memory codes followed by a decision process which either continues or terminates the search process by accepting or rejecting the output of the memory search. Storage and retrieval consists of three mechanisms each. The transfer mechanism consists of control processes which an individual uses to decide when, what, and how to store information in LTS. The placement mechanism determines where the information
will be stored and the image-production mechanism is responsible for determining what proportion of the information in STS will be placed into LTS. Retrieval consists of search, recovery, and response generation (Shiffrin & Atkinson, 1969). During a recursive search process, locations and images are examined while the recovery process determines how much information is placed in STS. The response generation process then examines the recovered information and the search is either continued or concluded.

Perhaps the best way to describe the three stores memory system is to discuss the model in terms of how information flows into and out of memory stores and how the individual controls that information flow (Atkinson & Shiffrin, 1971). It should be noted that all information in all memory stores consists of small increments or chunks of information that are associatively related to one another (Atkinson & Shiffrin).

First, information is presented from the environment and processed by various sensory systems. The sensory register then enters the information into STS where it remains for a period of time determined by the individual. While in STS, the information can be copied into LTS or, without rehearsal, it can be discarded or lost. Information entering STS can enter via audio or visual mechanisms. When information is entered into STS, LTS associations will be activated and entered into STS also. The short-term store is also considered working memory and it is here that “decisions are made, problems are solved and information is directed” (Atkinson & Shiffrin, 1971, p. 83).

Retrieval of information begins when the subject activates a category or subset of information in LTS, places it into STS, and searches this information subset for specific information. If the useful data are not there, the subject can then activate and search other subsets of information. Appropriate information can be selected and placed into STS to create a
search set. The individual can then select information from the selected search set which best meets the requirement of the stimulus that initially prompted the information search. If information is not found, the subject can decide to continue another search or may discontinue the search completely. If the search is continued, the subject will select another memory probe and the search cycle is repeated.

   During the search cycle, while information is being processed, rehearsal mechanisms determine if information is maintained in STS and control the transfer of information into the LTS. The three stores model of memory basically states that information from the environment flows through a set of sensory registers into a limited capacity STS. STS then sends information into LTS which has permanent and unlimited storage capacity. Any deficiencies in memory storage in STS or LTS or a problem with the sensory register could result in problems of coding, maintenance, or retrieval of information and would no doubt impact idea generation.

Baddeley and Hitch (1974)

   In 1974, Baddeley and Hitch proposed a three-component system of working memory as an alternative to the three stores model proposed by Atkinson and Shiffrin (1968). While Atkinson and Shiffrin (1968) looked at the memory system, Baddeley and Hitch looked at the memory process. This multi-component model of working memory is comprised of the central executive acting as control system, which has limited attentional control, and two peripheral slave systems: the phonological loop and the visuospatial sketchpad.

   The central executive acts as a control system which directs information to the two peripheral (slave) systems. The central executive is responsible for controlling and regulating information in the visuo-spatial sketchpad and phonological loop. The phonological loop consists of a phonological store which holds memory traces and an articulatory (sub-vocal)
rehearsal process. This process can renew a memory trace by retrieval and rehearsal of the memory trace. As items in the system increase, the first item will fade unless retrieved and rehearsed.

The function of the visuospatial sketchpad is to hold and manipulate visual imagery and is of limited capacity of two to three objects. The visuo-spatial sketchpad is used for manipulation and storage of visual, spatial, and possibly kinesthetic information. Baddeley added a fourth component, the episodic buffer, to the three component model. The episodic buffer provides a link to the visuo-spatial sketchpad and phonological loop and combines visual, spatial, and verbal information into time sequenced information units.

Studies have shown that students with LD have difficulties with several of the components of Baddeley’s model of working memory. Passolunghi and Siegel (2004) have shown that students with LD have a general working memory deficit. Specifically, there is a deficiency in the central executive component which hinders the ability of the individual to inhibit irrelevant information. This inability to screen out irrelevant information could act as a constraint in generating ideas specific to a given task.

**Craik and Lockhart (1972)**

Craik and Lockhart (1972) propose a system of memory composed of hierarchical levels of perceptual processing. These researchers postulate that presented stimuli are analyzed at different levels or stages. Preliminary stages compare stimulus features with stored information from past learning. Later stages of analysis are concerned with recognition and extraction of information. The concept of different stages of analysis is referred to as “depth of processing”. Greater depth of processing is synonymous with a greater degree of analysis. As information proceeds through stages of processing, it can be subject to elaboration and coding according to
pattern recognition. Ultimately, processing occurs at a semantic-associative stage or level of processing. Memory in this model can be viewed as a continuum which proceeds from transient objects of analysis to more permanent objects in semantic-associative processes.

Craig and Lockhart (1972) also endorse the idea of a central processor which has a limited capacity. The central processor can be used to maintain information at one level of processing by utilizing a process of rehearsal in a level referred to as primary memory (PM). The essential feature of PM is the continued processing of information. When this process is used to maintain information at the PM level, it is similar to short-term memory. Deeper processing facilitates the use of learned rules and prior knowledge which translates into more retention and manipulation of information. These researchers propose two types of processing: type I processing and type II processing. Type I processing is the repetition of analyses which have been previously conducted. Type II processing represents a deeper analysis of information. Only Type II processing can improve memory performance.

Craig and Lockhart (1972) postulate that the time information is stored in memory is related to the depth of analysis. Unnecessary information of a preliminary analysis is not stored while information which is deeply processed is stored longer term. This early analysis could be equal to the sensory store of other component models of memory and intermediate analysis of information could be equated to short-term memory. Information is perceived, coded, and elaborated on as it proceeds through the different levels of processing. Information processed in deeper levels and stages results in spread of encoding to more associative knowledge structures.

In summary, Craik and Lockhart (1972) propose a model of memory based on levels of processing rather than the four component model of working memory proposed by Baddeley and Hitch (1968). The limited capacity of STS is handled in the depth of processing model by
“assuming that a flexible central processor can be deployed to one of several levels in one of several encoding dimensions and that this central processor can only deal with a limited number of items at a given time” (p. 679). Items are maintained in PM by rehearsal at a level of processing. At deeper levels of processing the individual can make better use of encoded information because the information is coded at a more complex and semantic level. Deeper coding may depend on the usefulness of the information being coded. One difference between the three stores model and the deeper processing model is how information is maintained in primary memory and how it is transferred to a secondary memory structure. Atkinson and Shiffrin (1968), for instance, propose that rehearsal both maintains information in short-term stores and transfers it to LTS. Craik and Lockhart state that only deeper processing will lead to permanent storage and improvement in memory.

**Raaijmakers and Shiffrin’s (1985)**

One model which contains elements of memory storage and retrieval that almost all models of memory storage and retrieval have in common is Raaijmakers and Shiffrin’s (1985) model. These researchers proposed a memory network model that is based upon retrieval rather than storage. The Search for Associative Memory (SAM) model is based on an associative network of memory organization. Five principles guide the SAM theory: (a) LTM is permanent, and additions but not deletions are allowed; (b) LTM consists of an interconnected network of nodes in a matrix consisting of levels, layers, categories, and trees (retrieval structure); (c) memory retrieval is cue dependent; (e) memory retrieval can be problematic; and (f) temporal-contextual information is important. These nodes contain relationships and information units (i.e., schemata, frames) which are all connected either directly or indirectly to each other (Raaijmakers & Shiffrin).
Raaijmakers and Shiffrin (1985) provide a detailed discussion of how information is stored and retrieved during the retrieval process of information from long-term memory (long-term stores). SAM assumes retrieval is based on the strength of an associative affiliation between memory probes and memory images (units of information which have been unitized). These strengths will determine which images in LTM are activated by a given probe. The retrieval process begins when a stimulus is received by the individual. The individual can then utilize information presented by the task (cue) to construct a memory probe in short-term memory. This probe is sent to LTM and relevant nodes in the matrix of LTM are activated based on the strength of the cue-node association. Next, retrieved or sampled information is evaluated for task relevance and if accepted, used for problem solution. If information is rejected as irrelevant, another cue is constructed to form a subsequent memory probe and the process will be repeated.

**Anderson (1996)**

Another influential model of memory and learning which attempts to explain storage of both declarative and procedural knowledge is Anderson’s (1996) model Adaptive Character of Thought (ACT-R). Anderson states that “declarative and procedural knowledge are intimately connected in the ACT-R theory” (p. 356). Procedural knowledge is represented by production rules, and the conditions and actions of production rules are defined in terms of declarative structures. A production rule can only apply when rule-specific stipulations are met by the accessible knowledge in declarative memory.

In Anderson’s (1996) model, production rules break down procedural knowledge into if-then steps. Declarative knowledge is made up of schemata and chunks of information within schemata. When connected, declarative and procedural knowledge units are activated and are
used in working memory to generate appropriate ideas to solve problems. The difference between ACT-R and Atkinson and Shiffrin’s (1968) model is that the ACT-R model suggests the use of production rules which combine to form production systems. The production systems then direct the actions and conditions needed to attain a specific goal. ACT-R also suggests a system of spreading activation between declarative and procedural knowledge units during memory searches (production sequences). This activation of production rules may be non-hierarchical.

**Nijstad and Stroebe (2006)**

A more contemporary model, based on Raaijmakers and Shiffrin’s (1985) SAM model, which incorporates many of the main ideas, theories, and components of the previous theories, describes information processing and how memory structures and systems relate to idea generation. Nijstad and Stroebe (2006) examined how individuals in a group generate ideas. They used findings from this study to support a model of idea generation called the Search for Ideas in Associative Memory (SIAM). SIAM assumes there are two systems of memory. Long-term memory (LTM) is permanent, has unlimited capacity, and consists of an interconnected network of levels, categories, and associations. The purpose of working memory (WM), which has limited capacity, is to serve as a short-term storage system. SIAM assumes that knowledge retrieval is a process of repeated searches of associated memory structures.

SIAM supposes that a search process has two stages. Nijstad and Stroebe (2006) state that ideas cannot be generated without first referencing prior knowledge and that knowledge in LTM must be activated to begin the idea generation process. Images activated in LTM depend on the strength of the association between the search cue and features of the image and are stored in the form of images in WM. In the second phase, the image in WM is used to generate ideas.
In this phase, SIAM also assumes that LTM activation is dependent on cues generated in WM which in turn activate knowledge in LTM. Because ideas generated must be relevant to the problem or task, the task or problem is an important cue. Individuals monitor idea generation using a negative feedback loop which allows them to keep track of retrieval failure. This failure can result in an inability to activate knowledge or generate ideas. Rietzschel, Nijstad, and Stroebe (2007) suggest that information processing models may help explain the relationship between memory retrieval and idea generation.

Summary

Over time, Atkinson and Shiffrin’s (1968) model of memory has been used as a stepping stone to propose new models of information processing. Even though these models present differences, they do have common elements about how information is stored, organized, and retrieved from memory. Generally, long-term memory is viewed as a collection of interconnected units of data which represent various concepts and information relevant to those concepts. The degree of strength between information units determines the association between them. When an information unit is activated by a memory search, it becomes active in working memory and subsequent associated units are activated depending on the connection strength between them. Strongly connected nodes are more likely to be activated than those with weaker associations and as information from the activated nodes is reviewed, ideas are generated.

Nijstad and Strobe’s (2006) SIAM model would seem to be most applicable to the process of idea generation. One can easily visualize how a subject uses information to create new information to form ideas. Further, this model provides insight into how deficiencies or difficulty with any part of information processing could negatively impact students with disabilities, especially in academic content areas where idea generation is an important element.
in completing academic tasks.

While IPS focuses on the process of knowledge storage, retrieval, and production of new knowledge and on how components of a memory system function, it does not necessarily give a complete picture of the difficulties students with disabilities might experience with idea generation. It is also important to look at the mental processes that constitute the idea generation process (Mobley et al., 1992). Looking at the characteristics of creative individuals could help clarify the mental processes creative people use during idea generation. One area that has investigated these questions is the immense amount of literature on creativity.

**Creative Thinking**

**Defining Creativity and Creative Ideas**

Creative thinking is another approach to investigating the process of idea generation. Creativity commonly refers to the act of generating novel, useful, and appropriate solutions (ideas) to a task. Martindale (1989, p. 211) states that “Creativity has to do with the creation of new ideas” and involves a type of cognition that takes place within a combination of personal attributes and characteristics of the individual. According to Martindale, a creative idea has three characteristics: (a) a creative idea must be original; (b) it must be useful or appropriate for the context in which it occurs; and (c) it must actually be able to be put to use. Originality does not automatically make an idea creative; it must also be communicated to others in one fashion or another. Martindale goes on to state that creative ideas are combinations of old ideas.

Sternberg and Lubart’s (1999) definition of creativity and a creative idea mirrors the definition offered by Martindale (1989). According to Sternberg and Lubart, creativity is the ability to produce useful, novel, and relevant work defined by task constraints. In a problem solving context a creative idea is one that is novel, appropriate to the task or problem, useful, and
fulfills the problem or task requirements.

**The Creative Thinking Process**

Examining the cognitive processes involved in creative thinking and the types of information used in creative thinking can promote a better understanding of how creative individuals produce ideas. Runco (2007) notes that many theories of creative thinking look to associative processes to examine the idea generation process. Runco and Chand, (1995) proposed a two-tiered model of creative thinking. The first tier (controlling factors) of the model includes problem finding processes, ideation processes, and evaluation processes. The second (contributing factors) tier contains knowledge (declarative and procedural) and motivation (intrinsic and extrinsic) which may be dependent on the primary process in the first tier. In this model, the second and first tier variables combine and work together in processes which facilitate the production of numerous and original creative products.

Baughman and Mumford (1995) suggest there are core processes that creative people use to define problems, identify relevant knowledge structures, combine and reorganize this knowledge to create new knowledge structures, and then assess and use the new knowledge. The process of combining and reorganizing existing knowledge provides a means for producing new ideas or concepts. According to Baughman and Mumford, this process may be an important characteristic of creative thinking. Further, relations between categories may not be stored in memory but rather may be constructed in an iterative encoding-retrieval-elaboration process. This dynamic process of combining and reorganizing knowledge structures contrasts with a theory of mechanical search for rote associations between static features. Combination and reorganization of extant knowledge structures then is a basis for generating new ideas and is a foundation for creative thinking and achievement. Clearly individuals experiencing deficiencies
in reorganizing and combining prior knowledge would likely experience problems with ideation.

When considering idea generation from a creative cognition perspective, several points stand out: (1) ideation is a complex process which requires a family of skills and processes (Armbruster, 1989; Mobley et al, 1992; Runco, 1986, 2007; Runco & Chand, 1995); (2) ideation consists of fluency, originality, and flexibility (Guilford, 1950; Runco & Chand, 1995); and (3) in order to construct new ideas, extant knowledge must be accessed, retrieved from long-term memory, and reorganized and combined into new knowledge structures which can be used to construct a product which fulfills a task requirement (Baughman & Mumford, 1995). It would seem logical that individuals who are less productive at generating ideas may have difficulty accessing a variety of information categories or knowledge structures.

Finally, what is clear is that all of these approaches, whether from the information processing or creative thinking paradigm, have common components. All theories propose some type of mechanism to assimilate information from the environment and construct new ideas by accessing prior knowledge, evaluating it, combining it, and somehow reorganizing it to form a new symbol or idea.

**Characteristics of Creative People**

A question then, is what characteristics do creative people possess? Creative people are often thought of as being able to generate numerous and novel ideas that are useful and relevant to a problem or task. It may be pertinent to examine characteristics creative people have in common and how those characteristics might help guide the design of a strategy for facilitating idea generation in students with learning disabilities who seem to have specific difficulties generating ideas for academic tasks.

Guilford (1950) suggested creative individuals possess at least eight core characteristics:
(a) sensitivity to problems; (b) ideational fluency; (c) ability to generate novel ideas; (d) flexibility (adaptability) in thinking; (e) organizational abilities; (f) analyzing abilities; (g) complexity; and (h) evaluative abilities. Creative persons, then, can see or sense problems when other people do not and can generate a greater number of ideas (ideational fluency) or more novel (unusual but appropriate to problem) ideas than people who appear to be less creative. Creative people are able to change categories (Mobley et al., 1992) of possible solution sets easily (flexibility) and once they generate ideas, they are able to organize and analyze a larger number of interrelated ideas at once into more complex patterns. Finally, creative individuals are able to evaluate and rank the ideas they generate. Of these characteristics, Guilford focused primarily on fluency, flexibility, and novelty as the essential features of creativity.

Nickerson (1999) notes that variables that may affect, or play a role in the creative process, are personal ability, interests, and attitude. Intelligence, personal habits, knowledge and skills about a domain, personal beliefs, values, intrinsic motivation, and cognitive styles may also impact individual creativity. Some individuals have an ability to think analogically and make remote associations among information chunks more readily than other individuals. An important point is that even though these are some of the traits creative thinkers have, they are variables that, if taught, might enhance creative thinking in individuals (Nickerson).

No ideas, no matter how novel, are created without accessing past information in the formulation of those ideas. Nickerson (1999) stated that it was historical fact that no scientific theory has ever been produced without utilizing preceding scientific theories. Even Einstein noted he could not have conceived the theory of relativity without the work and findings of other scientists before him (Holton, 1981). Some research shows that information retrieved from long-term memory cannot contribute to the forming of new ideas or insights unless it is somehow
manipulated. There must be some type of transformational process which reorganizes and combines information (Baughman & Mumford, 1995; Mobley et al., 1992; Runco & Chand, 1995). Mobley et al. state that reorganization and combination of knowledge are critical to creative thinking and that combining different categories of information or reorganizing extant knowledge structures will result in generation of new ideas.

Using Wallas’s (1970) four stage model of creativity, Armbruster (1989) discussed metacognitive processes creative people have when compared to less creative people. The four stages of Wallace’s model are preparation, incubation, illumination, and verification. During preparation, individuals are acquiring needed knowledge and skills and storing the information in flexible knowledge structures or schemata. These flexible knowledge representations allow the individual to retrieve and reorganize extant knowledge into new and novel ideas or products. Flexible cognitive structures are the basis for restructuring information during ideation. Creative individuals may understand if their knowledge is flexible and they may be adept at flexibly encoding representations during the preparation phase of this model (Armbruster).

The second phase of Wallace’s model is the incubation phase. During this phase, solutions to the problem are not deliberately sought. Rather, inherent unconscious processes flexibly encode information structures that are being reorganized and combined into new knowledge structures or schemata. During this stage, the individual is reforming schemata into ideas that will satisfy requirements of the goal. Armbruster (1989) posits that creative individuals may be able to efficiently control the reorganization and combination of schemata.

The illumination phase is the “Aha” or ‘Eureka” moment when the reorganized unconscious schemata become conscious. Creative individuals may be more metacognitively aware of this experience. This phase may be the end of the creative process since some products
are fully formed at this stage. Usually, however, the process is completed in the final stage. During verification, the incomplete product is corrected and revised into the final product subject to internal and external standards. Armbruster (1989) postulates that creative individuals seem to be proficient at metacognitive skills required for the verification stage and are more able to revise and improve their products.

**Measuring Idea Generation**

Creative cognition is an active process that involves selecting information, searching for cues, finding and defining problems, and developing new appropriate ideas or solutions. Individuals are actively involved in this process. In order to produce novel ideas by combining and reorganizing information retrieved from memory, creative individuals tend to use divergent thinking. Guilford (1950) defined divergent thinking as the ability to produce many and varied ideas in response to an open-ended question, and divergent thinking tests are almost a necessity in the study of creativity (Guilford, 1956). Divergent thinkers are more flexible in their ability to switch to diverse information categories relative to the task. In divergent thinking, memory searches are more thorough and multi-directional (Brown, Tumeo, Larey, & Paulus, 1998; Guilford, 1956). The process of ideation is a combination of a family of skills and processes. Ideational fluency is the number of ideas produced, originality is the uniqueness or novelty of the idea, and flexibility is the ability of the individual to produce a diverse set of responses or to use a variety of categories when producing ideas (Runco, 1986).

Divergent thinking tests are perhaps the most widespread measures applied to measuring creative potential and have been shown to be psychometrically reliable with many populations (Guilford, 1959; Runco, 1986, 1991; Torrance, 1974). After receiving a prompt, individuals generate ideas which are scored for quality and quantity in terms of three typical variables:
fluency (number of ideas), flexibility (number of themes, classes, or categories of ideas), and originality, (novel ideas). According to Runco (1990), there are other operational definitions of ideational quantity and quality but fluency, flexibility, and originality are the most straightforward to determine and are the most widely used.

Scoring is generally conducted by two or more raters/judges. Each judge independently checks each response for the number of non-repetitive ideas and idea categories in each response (Coskun, 2005; Runco, 1985; Runco & Marz, 1992; Wallach & Kogan, 1966). A classic study by Wallace and Kogan gives a good description of procedures which generate five types of associated and related variables that are often used when assessing creativity. Instances, Alternative Uses, and Similarities are three verbal assessments. Line Meanings and Pattern Meanings are two creativity assessments which utilize visual rather than verbal stimuli.

Instances is a procedure that requires the subject to generate as many examples of a class concept in verbal terms. For example, the child may be asked to “Name all the round things you can think of.” The dependent variable of number is defined as the total number of responses the subject may give to a question. The child may answer hole, well, crater (round things in the ground) and/or may answer Frisbee, baseball, basketball (round things you can play games with). With respect to fluency and flexibility, these responses would represent six ideas and two categories (Wallace & Kogan, 1966).

The Alternative Uses method asks the subject to generate as many possible uses for a specified object. A classic example is the Brick Uses test. Given the prompt “Tell me all of the different ways you could use a brick,” respondents list all the ways they can imagine using a common brick. These answers are then scored for fluency and flexibility. Fluency is scored by adding up all of the relevant responses given (building a house, fireplace, barbecue, book case,
etc.) while counting the number of categories (construction, missile, weapon, boat anchor, etc.) is used to calculate the flexibility score (Guilford, 1967; Wallace & Kogan, 1966).

The Similarities method is a procedure in which the subject generates similarities between two specified objects. If asked “Tell me all the ways in which a cat and a mouse are alike,” the subject may respond that they have tails (physical characteristic) and they make some people scream (fear reaction). This could represent two ideas and two categories (Wallace & Kogan, 1966).

The creativity literature provides strong evidence that a common psychometrically valid method of assessing creativity is collecting data on ideational fluency and flexibility and using raters/judges to score responses. Because there is no attempt in this study to assess individual creativity, there is no reason to use the Line and Pattern meanings methods of assessment. The purpose of the current study then, is to design and implement a strategy which promotes ideational fluency and flexibility in students with LD

**Problems in Academic Content Areas**

Studies have shown that students with LD have difficulties related to deficiencies in information processing across content areas (Cermak, 1983; Passolunghi & Siegel, 2004; Swanson, 1987). Swanson suggested that information processing theory might be a model that can explain many of the difficulties students with LD have exhibited across academic areas. Also, there may be differences in the way information is stored in long-term memory that can result in constraints in academic areas (Carr & Thompson, 1996; Swanson). Swanson notes that "A child's knowledge base places formal restrictions on the class of logically possible strategies that can be used within a given academic domain" (pp. 156-157).

**Writing**
That students with disabilities have problems generating ideas across content areas (Brown & Campione, 1981; Brown & Palinscar, 1982; De La Paz, & Graham, 1997; Nelson, Benner, Lane, & Smith, 2004; Swanson, 1987) is well known. Additionally, it is well documented that students with LD have difficulties with writing (Harris et al., 2008). Difficulty with content generation may contribute to these problems. Students with LD generate fewer ideas for content than peers without disabilities and may generate content or ideas in a linear associative or knowledge telling fashion (Bereiter & Scardamalia, 1987; McCutchen, 1988). However, asking students to write more or providing cues to help them retrieve content increases the length, organization, and quality of composition (Graham, 1990).

Students with LD tend to produce impoverished or poorly organized compositions. Their compositions are less coherent, contain more mechanical errors, are shorter, less organized, and include more irrelevant content than their normally achieving peers (Englert & Raphael, 1988; MacArthur & Graham, 1987; Nodine, Barenbaum, & Newcomer, 1985, Troia, 2006). These problems indicate that students with writing difficulties may suffer from deficiencies in access to long-term memory or problems in working memory (Swanson, 2007).

**Mathematics**

Another area of difficulty for students with LD is mathematics. According to Geary (2004), among school-aged children, 5% have a memory insufficiency and 8% suffer a cognitive insufficiency that impacts their ability to learn mathematics concepts and procedures. Some children with mathematics disabilities have a persistent deficit in their ability to store or retrieve number combinations from long-term memory. Results from a study by Geary (2000) have shown that there may be a deficit in the ability to retrieve facts from a semantic long-term memory.
Passolunghi and Siegel (2001; 2004) investigated the relationship between working memory, mathematics ability, and cognitive impairments in children with difficulties in mathematics and whether working memory deficits in mathematics persist over time. Data indicated that children with learning disabilities had a generalized and persistent deficit in working memory. Results showed that this deficit was not extended to short-term memory which may indicate that storage capacity of students with learning disabilities in mathematics was similar to normally achieving peers but rather was used less efficiently. Finally, data from these studies suggested that working memory deficits in these students was related to an inability to reduce irrelevant information. Passolunghi and Siegel (2004) cautioned that other general factors could also be connected to working memory deficits.

Because mathematics often requires manipulating, changing, and remembering information, students with specific learning difficulties in mathematics may have difficulties with computations and solving word problems due to deficits or limitations in working memory (Passolunghi & Siegel, 2001). However, Geary (2004) states that the relationship between mathematics ability and working memory are not fully understood but it is clear that children with a mathematics learning disability have some form of deficit in working memory. It has been noted previously that idea generation requires the individual to retrieve and manipulate information in working memory. Problems with working memory in mathematics might present challenges during tasks requiring idea generation.

**Reading**

Difficulties in mathematics and difficulties with reading often are comorbid conditions that go hand in hand (Lewis, O'Donnell, Freebairn, & Taylor, 1998) and are related to deficits in working memory (Schuchardt, Maehler, & Hasselhorn, 2008; Swanson & Saez, 2003). For both
mathematics and reading, deficits in working memory impede integration of information retrieved from long-term memory with other information and may actually promote an information bottleneck which inhibits further cognitive processes. If working memory capacity is overloaded, task failure may result. This may further impact both incremental knowledge acquisition and skill acquisition in these content areas (Gathercole, et al, 2006).

Research has shown that some of these difficulties are related to deficits or deficiencies in the working memory structure. Swanson, Ashbaker, and Lee (1996) found that students with a reading learning disability show major deficits in working memory tasks when compared to normally achieving peers (Swanson, Ashbaker, & Lee). Gathercol et al. (2006) investigated the impact of working memory deficits on the mathematics and reading performance of students with reading disabilities. Data from the study suggested that working memory may limit skill and knowledge acquisition of mathematics and reading.

Further, academic abilities of students with reading disabilities are characterized by difficulties with text structure, background knowledge, reading speed, and vocabulary word recognition (Siegel, 2006; Williams, 2003), spelling, and reading comprehension (Gathercol et al, 2006). According to Siegel, phonology, syntax, and working memory are significantly disrupted in individuals with reading disabilities. This is important because word recognition and word decoding is a basic process and critical skill for reading comprehension (Siegel). Results from a study by Chiappe, Hasher, and Siegel (2000) showed that deficits in working memory were a characteristic of individuals with reading difficulties. Swanson et al. (1996) found that students with a reading learning disability show major deficits in working memory tasks when compared to normally achieving peers.

For some time it was thought that students with learning disabilities had a deficiency in
cognitive processing. Some research has shown, however, that students with learning disabilities may have a problem with inefficient rather than deficient cognitive processing (Passolunghi & Siegel, 2001, 2004). Gersten, et al. (2001) state that although students with LD possess the cognitive tools essential for processing information, for some reason they do not effectively process it. These researchers suggest that, for students with LD, this may be due to breakdowns in strategic processing and metacognition. Research, then, has provided ample evidence to suggest that problems in reading, mathematics, and writing are a result of either a deficient or inefficient working memory system.

Problems with memory processes as evidenced by difficulties in academic content areas provides insight into methods and practices that can be useful in addressing memory related deficiencies or constraints which negatively impact ideation of students with disabilities. Any attempt to design a strategy which would promote ideation in students with disabilities would need to consider the following key intervention variables.

**Key Intervention Variables**

Problems with memory processes are important because generation of ideas depends on combining and reorganizing extant knowledge structures (Baughman & Mumford, 1995; Mobley et al., 1992; Nijstad & Stroebe, 2006; Rietzschel et al., 2007). It seems intuitive, then, that problems with information processing would result in difficulties in ideation and any strategy designed to facilitate idea generation in students with LD should contain components which address the following deficits or deficiencies: (a) difficulty accessing information in long-term memory; (b) difficulty switching categories or idea sets (flexibility); (c) inability to conduct deeper memory searches; and (d) more efficient use of and support for working memory. Addressing these key intervention variables should promote ideational fluency and and diverse
thinking.

**Prior Knowledge**

Many students with LD have difficulty accessing prior knowledge (Brown & Campione, 1981; Swanson, 1987). Mobley et al. (1992) proposed that new ideas are a result of using prior knowledge structures which are organized into categories of facts and principles defined by exemplars that are typical of a category. A category of “mammals” would be defined by the exemplars “dog,” “cat,” and “cow.” These categories and exemplars are used in problem solving (Mobley et al.). In the process of idea generation, an individual can not create something (new ideas) from nothing. People must use existing knowledge structures or schemata to generate new ideas (Mobley et al.). Rietzschel, Nijstad, & Stroebe (2007) agree with Mobley et al. that retrieval of extant knowledge is necessary for fluent and flexible idea generation. A strategy which promotes activation of prior knowledge may address this issue. Marzano, Norford, Paynter, Pickering, & Gaddy (2001) state that prior knowledge is needed to fill in missing information which may facilitate learning.

**Self-questioning to Facilitate Fluency**

Studies have shown that instruction in use of self-questioning strategies can improve reading comprehension for students with LD (Carr & Thompson, 1996). King (1991) found that training students to use strategic questions facilitated problem solving. King posits that strategic questions enhanced cognitive and metacognitive processes in questioners and suggests that using strategic questioning to direct the problem solving process may be a key component in student success when solving problems. Data from a study by Ge and Land (2003) support King’s findings. When used as a scaffolding strategy, question prompts facilitated novice problem solvers’ cognition and metacognition and facilitated problem solving on ill-structured tasks (Ge
& Land). These researchers found that structured guidance through questioning improved knowledge representation and questions could serve as cues to help focus students’ attention on relevant information. Marzano et al. (2001) state that ideally cues and questions can trigger students’ memories and that inferential questions (who, what, how) and analytic questions require students to use prior knowledge and new knowledge.

A review by Rosenshine, Meister, & Chapman (1996) was based around five types of procedural prompts: (a) signal words; (b) generic question stems and generic questions; (c) main idea of the passage; (d) question types; and (e) story grammar categories. These procedural prompts were designed to teach students how to generate questions after reading or listening to a passage. Using procedural prompts to generate questions resulted in improved comprehension. Signal words and generic question stems obtained the highest effect sizes. Further, generic questions utilizing stems may help students develop more comprehensive questions. According to Rosenshine et al., these questions facilitated a deeper search, recall, and assimilation and integration of prior knowledge.

**Inducing Deeper Knowledge Searches**

Studies have indicated that people will search semantic memory superficially, and then switch categories or stop altogether if they feel they are not being successful (Rietzschel et al., 2007). Ward (1994) suggests that individuals will take the path of least resistance and search only the information which is most available. If an individual could be taught to explore a semantic category more deeply than they normally would, they should be able to generate more ideas within each category. A self-questioning strategy may be able to induce a deeper memory search by providing a richer array of cues for the individual.
Promoting Diverse Thinking in Memory Searches

Providing a means of increasing an individual’s ability to switch categories is another way to increase the number of ideas generated for a given task. Increasing the individual’s ability to think divergently should result in an increase in idea themes or sets searched during the idea generation process. Flexibility is commonly regarded as a crucial element in the idea generation process (Guilford, 1967). Coskun, Paulus, Brown, and Sherwood (2000) found that breaking a brainstorming problem into smaller sub-categories helped subjects increase ideas within each sub-category.

Supporting Working Memory

Studies have shown that long-term memory and visual short-term memory is intact in children with reading disabilities, but they exhibit deficient verbal short-term memory. This would indicate that these students have an impaired phonological loop in the working memory system (Kibby & Cohen, 2008). Other researchers suggest that there are deficits in the central executive and/or the phonological loop (Swanson & Ashbaker, 2000; Swanson & Howell, 2001). To facilitate a more efficient use of working memory, Newell and Simon (1972) suggest using visual aids such as graphic organizers to extend the capacity of short-term memory.

Individuals with LD often have problems with text production which can interfere with the writing process in several ways. It can interfere with higher order skills such as content generation and planning. When dealing with the mechanics of writing (spelling, punctuation, and physical act of writing) the writer may forget an idea or related ideas they had been thinking about. Difficulties with the mechanics of writing may decrease overall production rate. Slow text production can obstruct content generation and idea generation simply because the writer forgets about the idea when dealing with difficulties related to text production.
Dictation, then, can be used to support working memory and may be beneficial for students with LD when it comes to academic tasks requiring written responses. Allowing the students to dictate a response may allow them to compose at the same speed as they think resulting in more productivity. Dictation may prevent loss of good ideas and aid in capturing ideas before they are forgotten. Dictation can enable students with LD to focus on higher level functions such as planning and idea generation rather than mechanics of writing (De La Paz, 1999; De La Paz & Graham, 1997).

**Intervention**

**Rationale**

Some researchers feel that almost anyone with normal cognitive abilities can construct, to some degree, a creative product in some domain (Amabile, 1983) and that students can be taught to enhance their creativity. The research points to many variables that may affect or play a role in the creative process. Variables may be personal ability, interests, attitude, and motivation. Intelligence, personal habits, knowledge and skills about a domain, personal beliefs, values, and cognitive styles may impact individual creativity (Nickerson, 1999). Nickerson offers some suggestions, variables, and techniques that may enhance creativity: (a) establish a purpose; (b) build basic skills so the individual has the needed foundational skills; (c) promote acquisition of domain-specific knowledge; (d) intrinsic motivation is crucial; (e) goal setting promotes perseverance; and (f) it is important for an individual to believe they can succeed in a given task. Graham and Harris (2003) have found that teaching metacognitive skills to students has been useful and results have been positive. One instructional approach which considers Nickerson’s (1999) suggestions is self-regulated strategy development (SRSD).
**Metacognition and SRSD**

Types of knowledge represented in memory are declarative, procedural, and self-regulatory knowledge (Schraw, 2006). Declarative knowledge refers to what the individual knows and can be facts and concepts that help an individual construct a conceptual understanding of a particular domain. For example, these facts may be colors, numbers, or birds. Concepts symbolize categories of facts such as animals or plants. Procedural knowledge or “know how” knowledge is sometimes referred to as metacognitive knowledge. Both procedural and declarative knowledge are important to and can affect the creative thinking process. They can also promote or restrain creative ideation (Runco & Chand, 1995). This suggests that when teaching a strategy, it would benefit the student if declarative, procedural, and self-regulatory knowledge were incorporated into the strategy.

Students with LD face challenges which can be related to components of metacognition (Graham & Harris, 2003). The first element of metacognitive skill, knowledge of cognition (Harris et al., in press), is needed to complete goals specific to a particular task. SRSD instruction gives the struggling writer a structured format in which the learner can (a) successfully assimilate self-knowledge specific to a particular task (declarative knowledge), (b) adequately apply learned declarative knowledge (procedural knowledge), and (c) appropriately combine both declarative and procedural knowledge needed to complete the requirements of the task (conditional knowledge).

The inherent structure of SRSD instruction facilitates the development of declarative, procedural, and conditional knowledge. Declarative knowledge is provided by evaluating and addressing personal abilities or limitations of the student and by explicitly teaching and discussing skills and knowledge required to complete a particular assignment or fulfill a task.
SRSD instruction aids development of procedural knowledge during instruction as the student progresses through the six stages of SRSD strategy acquisition. In addition, the student acquires both procedural and conditional knowledge as the teacher discusses the strategy being used, models proper use of metacognitive and cognitive skills and strategies, and collaboratively works with the student. The process continues until the student exhibits mastery of the strategy by attaining a preset criterion goal specific to the task or assignment.

SRSD instruction also facilitates acquisition of the second major element of metacognition, conscious regulation and control of cognition (Harris et al., in press). One problem common to individuals with disabilities is the inability to effectively self-regulate behaviors required to fulfill a task. For example, results of a meta-analysis by Reid, Trout, and Schartz (2005) indicated that use of four self-regulation interventions improved on-task behaviors, decreased inappropriate behaviors, and increased academic productivity and accuracy. SRSD imbeds components of validated theories in its design to form a practical and flexible instructional strategy that can be adopted to meet the needs of a diverse group of students with special needs. This strategy can be used to teach any number of skills to students across all writing genres, math, and science content areas (Graham & Harris, 2003). Students are instructed in planning, time management, goal setting, and use of appropriate cognitive strategies necessary for completing assignments. SRSD provides a flexible instructional model that can be used to design a strategy which specifically teaches a student to generate ideas in response to an open-ended question requiring divergent thinking skills. SRSD instruction employs explicit, criterion-based instruction to facilitate learning and mastery of content. Students learn four self-regulation strategies (self-monitoring, goal setting, self-instruction, and self-reinforcement) and responsibility for learning is gradually transferred to the student. Six stages of strategy
acquisition and four self-regulation procedures provide the structural foundation for SRSD instruction (Graham & Harris, 1996).

In the first instructional stage, “Develop background knowledge,” the student is taught prerequisite skills and background knowledge they will need to understand and use the strategies. During the second stage, “Discuss it,” student and teacher inspect the current level of student performance, discuss the strategy and when and how to use it, and make commitments to work together to do their best to learn and use the strategy. “Model it” is the third stage. The teacher first models out loud how to use the strategy and the student develops self-statements he or she can use in later lessons. Fourth, during the “Memorize it” stage, the mnemonic and steps of the strategy are memorized. The fifth stage, “Support it,” is student practice of the strategy and self-regulation processes using supplied supports. Finally, the teacher scaffolds and supports student learning until the student can demonstrate “Independent performance,” the sixth stage of strategy acquisition.

Instruction on self-regulation and content specific cognitive strategies are imbedded in SRSD lessons. Because SRSD has been proven to be an effective platform for teaching strategies across a variety of content areas, it was chosen as the instructional approach for this study.

**RAN Strategy Stages**

Research has shown that students with LD have difficulty accessing information from long-term memory (Brown & Campione, 1981; Swanson, 1987). Also, retrieval of prior knowledge from long-term memory is essential for ideation fluency and flexibility (Rietzschel, Nijstad, & Stroebe, 2007). The first step in the RAN strategy is R – Review key words and phrases. This step is designed to activate prior knowledge, promote problem definition, and
provide cues for probe construction to initiate long-term memory searches. Activation of prior knowledge should facilitate a spread of activation of associated memories and promote more extended memory searches. The R strategy step promotes activation of prior knowledge and should facilitate idea generation.

The second stage in the RAN strategy is A – Ask What-How, Who-How questions, and is designed to promote deeper memory searches and more diverse thinking. Studies have shown that strategic questioning facilitated problem solving and improved cognitive and metacognitive processes in students (King, 1991). Ge and Land (2003) also found that use of question prompts as a scaffolding strategy facilitated novice problem solvers’ cognition and metacognition, problem solving on ill-structured tasks, improved knowledge representations and served as cues to focus student attention on pertinent information. Questions can also serve as cues to help focus students’ attention on relevant information. Rosenshine et al. (1996) found generic questions utilizing stems helped students develop more comprehensive questions and these questions facilitated a deeper memory search, recall, and assimilation of prior knowledge.

The Ask step also prompts the students to think of other possible idea sets by thinking about the prompt from other perspectives. Runco (1986) found that flexibility in children’s idea generation increased as they worked through an open ended task. By explicitly asking the students to think of other perspectives and continue to ask What-How and Who-How questions, the memory search might be extended into other relevant categories and promote a more divergent thinking style.

The last step of the strategy is N – Note and list my ideas and ask if there are other possibilities for ideas. The students ask themselves if ideas generated in the R and A stages of the strategy can help them think of more ideas. The purpose of checking notes is to use
previously generated ideas to extend a memory search, start another memory search, construct a new cue, or help the student in switching categories. Providing a means of increasing an individual’s ability to switch categories is another way to increase the number of ideas generated for a given task. Increasing flexibility via divergent thinking should result in an increase in categories searched during the idea generation process and an increase in idea generation performance. Increased idea generation is commonly a precursor to increased use of idea themes or sets (Baughman & Mumford, 1995). Flexibility is commonly regarded as a crucial element in the idea generation process (Guilford, 1967).
CHAPTER 3
METHODS

This study examined the effects of a strategy designed to promote the ideational fluency and flexibility of students who had been identified by their special education teachers as students who had difficulties generating ideas across a variety of content areas (i.e., writing, social studies, etc.). The previous review of idea generation literature of studies from the fields of information processing and creative cognition indicated that deficiencies or deficits in retrieval of information from long term memory and manipulation and reorganization of information in working memory are problematic in idea generation for students with learning disabilities (LD) (Gathercole et al., 2006; Swanson, Ashbaker, & Lee, 1996; Swanson & Saez, 2003). Three methods were noted which could be used to enhance ideational fluency and flexibility: (a) promote deeper memory searches, (b) promote the student’s ability to switch idea categories, (c) and support and extend the capacity of working memory.

In this study, instruction for ideational fluency and flexibility was designed within a self-regulated strategy development (SRSD) instructional model. SRSD instruction is designed to facilitate student acquisition and application of task specific metacognitive skills. SRSD was chosen as the format for this intervention because it has been shown to be affective across multiple writing genres, content areas, and with diverse disability populations (Baker, Chard, Ketterlin-Geller, Apichatabutra, & Boabler, 2009; Graham & Harris, 2003; Taft & Mason, in press). Further, SRSD instruction has been empirically validated in over 27 single-subject design studies (Harris et al., in press).

The design of the researcher-developed strategy for idea generation and choice of dependent variables for this study accounts for three requirements suggested by Amabile (1996)
for use in social-psychological studies. First, the task must lead to a product or response that is clearly observable and which can be made available to and assessed by appropriate judges. Second, the task should be open-ended and permit considerable flexibility and novelty in responses. Finally, there should not be large individual differences in performances and performance should not depend heavily on specific skills such as verbal fluency or writing fluency skills in which some individuals may be more proficient than others.

The proposed idea generation strategy met these requirements. The task required subjects to produce relevant ideas (observable product) in response to an open-ended alternate uses question. These responses were then assessed by judges. Students participating in this study were chosen by their special education teacher specifically because they had difficulty generating ideas in academic content areas and because they met other selection criterion (e.g., performance on curriculum based measures and state assessments).

It should be noted that this study utilized single-subject research methodology. The purpose of single-subject methodology is to document a causal or functional relationship between independent and dependent variables (Horner, Carr, Halle, McGee, Odom, & Wolery, 2005). Several defining characteristics of this methodology are discussed by Horner et al.:: (a) single-subject design studies typically involve multiple participants in a single study, and each participant serves as his or her own control; (b) baseline performance (i.e., performance before introduction of the independent variable) is compared to performance during intervention, after intervention, or both; and (c) a predictable pattern of response usually requires five or more data points but fewer data points are acceptable in specific cases if a trend in the direction predicted by the intervention is not noted. Further, the experimental design used in this study was a single-subject multiple baseline across participants design.
Participants

Three seventh-grade students were asked to take part in the study. Students were included in the general education classrooms and received pullout special education services in the student’s special education resource room. Institutional Review Board (IRB) approval was obtained for this project. Both students and parents signed consent forms authorizing participation in the study (Appendix G). Students selected and included met the following criteria: (a) qualified for special education services by being identified with a high incidence disability (i.e., learning disability, emotional disorder, mild mental retardation, etc); (b) had writing goals and/or writing accommodations which included an idea generation component as part of an Individualized Educational Plan (IEP); (c) demonstrated low performance in writing assessment probes using AIMSweb progress monitoring probes and data or low performance on the Pennsylvania State assessment tests. All three students qualified as participants for this study as determined by criteria established by IRB # 24762 and by state and school district criteria which identify students with LD.

All three participating students scored two grade levels below their peers on AIMSweb assessments. Two of the students tested at or below the Basic level for 5th grade on the state writing assessment tests. The third student, Rachael, tested at or below the Proficient level for 5th grade on the state writing assessment tests. Although Rachael tested in the Proficient range, it was the lowest score possible to be classified in that ability range. The state assessment for writing is only given every three years.

Thomas. Thomas was a seventh grade African American male who had been identified with a specific learning disability. Thomas also struggled in the area of reading fluency, reading comprehension, and writing. He received direct instruction for reading prior to English class and
received instruction for writing twice out of a six day cycle. Like Alex, he benefited from adult assistance in an inclusive classroom and received accommodations and modifications related to his learning disability. He was reading and writing below grade level and had noticeable difficulties with writing mechanics and was difficult to read. According to his special education teacher, he had difficulties with planning and organization related to academic tasks. Thomas’s special education teacher states that his attention deficit, low reasoning ability, weak working memory, and slower processing speed makes learning in a regular education classroom difficult.

I found Thomas to be a very easy going and good natured young man. During all baseline and instruction phases of the study he seemed relaxed, eager to participate, and interested in how well he was doing. He was very goal oriented during instruction and always wanted to know if he reached his idea generation goal. After instruction, however, Thomas’s demeanor seemed to change. During post-instruction sessions he was not as outgoing as he had been during the first two phases of the study. He did not have difficulty generating ideas during instruction. However, he had problems generating ideas during all three post-instruction sessions. Approximately one week later, during a maintenance session, his attitude and demeanor was more like the young man I saw during the baseline and instruction conditions.

His special education teacher did not know of any events or conditions in school or out of school that might have affected his behavior during the post-instruction phase of the intervention. Overall, Thomas was a good natured student who was very cooperative during baseline, instruction, and maintenance phases of the intervention. Neither I nor the special education teachers knew why Thomas demeanor changed during the post-instruction phase of the study.

**Rachael.** Rachael, a seventh grade Hispanic female, was outgoing and good natured during all phases of the study. Rachael received direct instruction for writing. She was receiving
direct instruction targeting skills in word usage, grammar, identifying problems with arguments, and using formats for expressing ideas and developing higher order thinking skills. The special education teacher state Rachael had difficulty understanding instructions and often rushed and missed important parts of instructions. When she slowed down and took her time she was better able to understand the instructions and she could then complete required tasks. Rachael performed better when projects or assignments were broken into smaller steps.

Her present level of performance was slightly lower than grade level. The TerraNova CAT achievement test indicated Rachael was performing below grade level in the areas of reading, language, and math. Overall, on this assessment, she placed in the lower 17th National Percentile. Her weakest area was in language. Rachael scored in the 9th National Percentile indicating she scored higher than only nine percent of the students in the nation.

I found Rachael to be a cheerful, outgoing, and polite young lady. She always seemed to be eager to learn. During instruction she openly acknowledged that she had trouble thinking of ideas for assignments. Rachael cooperated and worked hard during all phases of the study.

**Alex.** Alex, a seventh grade Caucasian male, moved to his present school at the start of sixth grade. He was identified with a specific learning disability and was receiving learning support services in the area of written expression. He also received speech and language support. Alex struggled in the areas of reading fluency and writing. Alex had always received instruction in a self-contained setting until the present school year. In order to be successful, his special education teacher stated he needed many accommodations and modifications. The special education teacher also noted he was gaining confidence in the inclusive setting and was quick to ask questions when he was unclear of directions or when he needed assistance. He
received direct instruction for reading everyday before going to English class. He also received direct instruction for writing three times out of a 6-day cycle.

Alex benefited from adult assistance in all of his core classes. Alex was reading at a fourth grade reading level and his writing was below grade level. He struggled in the areas of sentence structure, spelling, mechanics and idea generation. When reading, Alex struggled with prefix and suffix parts of words and often guessed at word endings. According to his special education teacher, these difficulties impacted his writing and ability to achieve academically. There was little home involvement or support for homework or other school related activities. Alex was also eligible for free or reduced lunches.

When I first met Alex, he refused to talk to me or answer any greeting. During the baseline condition he limited conversation to responses to questions or generating his idea list in response to the prompt. This attitude continued over seven baseline prompt sessions and through the first lesson session. However, during the second lesson, Alex became interested in the lessons and began to participate. He was very interested in knowing if he had attained his preset idea generation goal and took pride in reaching and graphing his goals on the RAN graphing sheet. Generally, Alex worked hard and had a positive attitude during instruction. He seemed to take a sincere interest in his learning.

**Instructional Setting**

This study was conducted in a middle school in a Northeastern university-city. Approximately 800 students attended the school. Eleven percent of the students were eligible for free or reduced lunch. Approximately 15% of the students received special education services under IDEA. Special education students received services principally in general education classrooms. Pullout instruction addressed specific learning needs.
All baseline, instruction, and maintenance sessions for Alex and Thomas were conducted in the library’s video library room. This small eight-by-ten room was very quite and contained two desks that were used during data collection and instructional sessions. There were no distractions during any of the sessions for both Alex and Thomas.

Instruction for Rachael took place in her pull out special education teacher’s classroom. The room was sectioned into two halves by a room divider. The front half of the room contained one large round table which students could use for group projects and other group activities. The back half of the room contained 6 desks and one foldout table. Data collection and instructional sessions were conducted in the back half of the room at the fold out table. Generally, there were no other students present in the classroom during data collection or instruction sessions for Rachael. There were no interruptions or distractions during any of the sessions.

Measures

Participant Assessment Measures

For three students, data were obtained from two sources: (a) AIMSweb progress monitoring system and (b) the State Academic Content Standards assessment tests. AIMSweb is a progress monitoring system which utilizes curriculum based measures (CBM) testing materials and web-based software for monitoring reading, literacy, writing, and math. AIMSweb emphasizes direct, frequent, and continuous student assessment and is utilized by the participant’s school district and teachers as a writing assessment tool. For Rachael, the TerraNova CAT assessment test provided national percentile scores for this assessment in the areas of language, math, and reading.

Outcome Measures

Three variables which are the most straight forward to score and most commonly used to
assess the creative ability of an individual during the process of idea generation are fluency, flexibility, and originality (Guilford, 1950; Runco, 1990). In response to an open-ended question, individuals are prompted to generate ideas which can then be scored in terms of fluency (quantity), flexibility (adaptability), and originality (novelty). Responses are then scored by simply counting the number of distinct, relevant ideas and by counting the number of categories used to generate appropriate ideas in response to the prompt.

The strategy used in this study was designed to increase the number of ideas a student with a disability could produce. In other words, the strategy was designed to increase ideational fluency. For the present study, only changes in fluency were used to determine the effect of the treatment on idea generation ability of the participants. Flexibility and originality were not measured because the goal of the intervention ultimately was to promote ideation fluency. For the purpose of this study, fluency was defined as the total number of relevant ideas produced in response to an open-ended alternate uses prompt during the ideation process (Guilford, 1951; Runco, 1986, 1990). Ideas must state a relevant, realistic use for the prompt object. Stating something that can be done to the object (as opposed to a use for the object) was not accepted as a valid idea (Guilford, 1951; Torrance, 1974).

**Scoring protocol and reliability.** The scoring protocol for fluency in this study was modeled after the Unusual Uses of Tin Cans activity found in the Torrance Tests of Creative Thinking (Torrance, 1974). The fluency score is the total number of idea/uses produced in response to an alternative uses prompt. Any idea generated which expressed a use for an object in a prompt was counted as one idea. Redundant ideas and fantastic or impossible ideas beyond reality (Torrance) were not counted. Ideas were required to be appropriate and relevant for the prompt and had to express a use of the object. For example, if prompted to generate alternate
uses for an object, the idea had to be a valid, distinct, and appropriate use for the object, not something that could be done to the object (Torrance). To illustrate, if the prompt asks for alternative uses for a shovel, the answer “Push it into the ground” would not be counted as an idea. The answer “push it into the ground to dig a hole”, however, would be a use for a shovel and would be counted as an idea.

All responses and lessons were taped, transcribed, and scored by two independent judges. One judge was an advanced doctoral student well versed in creativity literature and problem solving. The second judge held a Ph. D. in special education and had 28 years experience as a special educator and administrator. Both judges were unfamiliar with the students and school participating in the study. Prior to scoring student products, the researcher conducted two forty-five minute training sessions to ensure responses were scored accurately and reliably. Scoring procedures were discussed and judges practiced scoring sample responses.

Responses collected during the study were coded in order to maintain confidentiality and copies of the responses were given to each judge. Each judge scored responses independently for fluency (number of ideas). When there were disagreements in the score, judges discussed the response to determine if an agreement could be reached. If no agreement was reached, the average of the scores for fluency was used as the final score for each measure. Interrater reliability was computed by dividing the total number of agreements between scorers by the total number of responses to prompts and multiplied by 100 to obtain a percentage (Tawny & Gast, 1984). Examples of idea counts are presented in the scoring example provided in Table 1.
Table 1

*Idea Scoring Example: “Tell me all the different ways you can use an aluminum can.”*

<table>
<thead>
<tr>
<th>Object Use</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pencil holder</td>
<td>1</td>
</tr>
<tr>
<td>Put two together with string to make a phone</td>
<td>1</td>
</tr>
<tr>
<td>Piggy bank</td>
<td>1</td>
</tr>
<tr>
<td>Dog house</td>
<td>1</td>
</tr>
<tr>
<td>Drum</td>
<td>1</td>
</tr>
<tr>
<td>Build a real race car</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Ideas Score</strong></td>
<td>5</td>
</tr>
</tbody>
</table>

**Origin of ideas by strategy stage.** During instruction, students were given a piece of notebook paper and a pencil to construct a notes page. Students wrote the letters R, A, and N along with prompts for questions included in strategy instruction lessons (Appendix A). These notes acted as prompts to facilitate idea generation as the students progressed through strategy stages. When students were finished constructing their notes pages, they were taught to cross out What and Who question answers. Students constructed notes pages for post-instruction and maintenance phase prompts. These notes pages (Appendix F) provided a permanent product to use to produce a descriptive analysis of the origin of ideas by strategy stage.

Each notes page produced by students in response to post-instruction and maintenance alternative uses prompts was examined to determine which idea was generated in the R, A, or N stage of the RAN strategy. Only ideas previously scored by judges as valid ideas were included...
in idea counts for the origin of ideas by strategy stages analysis. After a list of ideas by strategy stage was completed for each student, percentages of ideas generated were calculated by dividing the number of total ideas in a particular stage by the total number of ideas generated during post-instruction and maintenance and multiplying by 100%. For example, Rachael generated 23 ideas in the R, A, and N stages of the study. Ten of these ideas were generated during the R stage of RAN. This equates to 43.47% of her total ideas generated in the R stage. This analysis was repeated for each student.

It is important to note that this analysis gives the researcher an approximation of the origin by strategy stage of ideas generated during post-instruction and maintenance. It was not possible to deduce precisely which question or group of questions actually generated a specific idea. The analysis was not intended to and was not capable of determining what the students were thinking during the idea generation process and how that thinking may have emerged as the students progressed through the strategy. What was determined was which stage a student actually produced an idea. Thomas, for example, wrote many of his ideas for the first time in the R stage of the strategy (Appendix F).

**Social validity.** Following post-instruction testing, students were asked six questions adapted from previous studies (Harris, Graham, & Mason, 2004; Mason & Shriner, 2008): (1) Has using the RAN strategy helped you generate ideas? (2) What have you learned since working with me/instructor? (3) How do you think the RAN strategy will help other children? (4) If you were the instructor, what would you change in the lessons? Why? (5) If you were the instructor, would you add anything to help children learn to generate ideas? (6) From these lessons, what things have most helped you generate ideas? Student responses were transcribed and recorded for accuracy. Responses to the social validity questionnaire were analyzed
Descriptively.

Assessment Prompts

The Alternative Uses method (Wallach & Kogan, 1966) asks a student to generate as many possible uses for a specified object. Alternate Uses prompts which were used in this study are prompts utilized in previous creativity studies (e.g., Wallach & Kogan). The order of the prompts were randomized and then counterbalanced to account for differences across prompts. Questions provided by or similar to the ones used by Wallach and Kogan are:

1. “Tell me all the different ways you could use a newspaper.”
2. “Tell me all the different ways you could use a screwdriver.”
3. “Tell me all the different ways you could use an automobile tire.”
4. “Tell me all the different ways you could use a cork.”
5. “Tell me all the different ways you could use a shoe.”
6. “Tell me all the different ways you could use a chair.”
7. “Tell me all the different ways you could use a key – the kind used in doors.”
8. “Tell me all the different ways you could use a button – the kind that is used on clothing.”
9. “Tell me all the different ways you could use a pencil.”
10. “Tell me all the different ways you could use a string.”
12. “Tell me all the different ways you could use a cardboard box.”
13. “Tell me all the different ways you could use an aluminum can.”

Assessment Procedures

Administration of Alternate Uses prompts was modeled after procedures suggested by Torrance (1974) and Wallach and Kogan (1966). The researcher delivered all assessment
prompts to each student. Assessment sessions took place in the student’s special education classroom at a time designated by the special education teacher when there was the least possibility of distraction for the student. Assessment prompts administered across all phases of the study (baseline, instruction, post-instruction, maintenance) were scored for fluency.

**Baseline.** Baseline assessments were conducted in the following manner (see Appendix D). The instructor placed a blank lined sheet of paper, two sharpened pencils and the tape recorder in front of the student. Next, the instructor said to the student: “I am going to ask you to tell me some ideas about a topic. I will use this tape recorder to tape what you say so that I can go back and listen to what you said later.” Next, the instructor said: “I am going to ask you to tell me all of the different ways that an object can be used. I will read you a prompt and then I want you to think of as many ideas as you can. There are no wrong ideas and you can take as much time as you need. You may use this paper to take notes to help you while you think of ideas. Listen carefully to what I read.” The prompt was read out loud to the student two times.

The instructor told the student to take their time and think of as many ideas as they could and that the instructor would write down the student’s ideas as they thought of them. When the student was ready to tell the instructor their ideas, the tape recorder was turned on and the instructor transcribed the response as the student stated their ideas. If the student stopped, they were asked if they have any more ideas. If the student was finished the session was over.

**Instruction.** Data was collected from the student responses generated during independent practice in lesson five. Procedures for this assessment were the same procedures used during baseline, post-instruction, and maintenance.

**Post-instruction.** Post-instruction assessment procedures were identical to baseline assessment procedures. The students were told to listen carefully while prompts are read to
them. They were asked to list as many ideas as they could in response to an Alternate Uses prompt. The prompt was read a second time. No other assistance was provided and there was no time limit for responses. As in the baseline condition, a paper and pencil were provided for the student to use if they wished to do so.

**Maintenance.** The assessment procedure during maintenance was identical to baseline and post-instruction procedures.

**Intervention**

All lessons and instruction were delivered in a one-to-one instructor-student format. The researcher taught all lessons and followed the SRSD model of instruction briefly described in the following section. Although SRSD is criterion-based, no studies were found which could be used to calculate a criterion level for idea generation for students with disabilities. Therefore, instruction was time-based. It was estimated, based on a prior study (Taft, unpublished manuscript), that a minimum of five lessons would be required. However, during lesson instruction, individual student goals for each lesson were agreed upon by the student and researcher to assist in determining student mastery of the strategy.

RAN (Review, Ask, Note), a strategy that aids the student in generating ideas, contains three steps: (a) Review key words or phrases, (b) Ask myself What – How, Who – How questions; and (c) Note and list my ideas. The principles of SRSD instruction were used to teach students how to use the RAN strategy. Six steps for strategy acquisition are imbedded in SRSD lessons: develop pre-skills, discuss the strategy, model the strategy, memorize the strategy, guided practice, and independent practice (Graham, Harris & Sawyer, 1987; Graham & Harris, 2003; Harris, Graham, Mason, & Friedlander, 2008). Four important self-regulation skills were taught during instruction: (a) self-monitoring; (b) goal setting; (c) self-reinforcement; and (d)
self-instruction.

**RAN Strategy Stages**

**R stage.** Review key words and phrases, the first stage of the RAN strategy was designed to activate the individual’s extant or prior knowledge, extend the initial memory search, and provide cues to initiate additional memory searches if the original memory search was unsuccessful. Research indicates that new ideas cannot be created if prior knowledge is not available from LTM (Baughman & Mumford, 1995; Nijstad & Strobe, 2006) and used to manipulate and to reorganize that knowledge to construct new knowledge (Mobley, et al., 1992; Runco & Chand, 1995). Studies have also shown that students with LD have difficulty accessing prior knowledge (Brown & Campione, 1981; Swanson, 1987).

Therefore, it seemed crucial to incorporate a step in the RAN strategy that focused on activating prior knowledge. According to Marzano et al., (2010) inferential questions can facilitate activation and use of prior knowledge. R stage questions ask the learner to identify the main idea by reviewing key words and phrases. Identifying the key words or phrases can help clarify prompt requirements by specifically identifying and focusing on the prompt object and on the task at hand. Properly identifying the task requirements may be a crucial in initiating successful memory searches. Studies have also shown that initial memory searches may be superficial if the initial memory search is not successful in retrieving relevant information (Rietzschel et al., 2007). Rosenshine et al. (1996) suggested that procedural prompts such as questions facilitated deeper memory searches, recall, and reorganization and combination of prior knowledge. The questions in the first stage of the RAN strategy were meant to address the concerns discussed above.

**A stage.** The purpose of the second stage of the RAN strategy, Ask What-How, Who-
How questions, is to promote deeper more thorough memory searches and more diverse (flexible) thinking. A convergent thinking style generates fewer ideas than a divergent thinking style because fewer idea categories are searched during memory searches. Students with LD often have difficulty generating ideas for writing (Scardamalia & Bereiter, 1987) because they employ a convergent, less flexible, think-say process to writing. In a knowledge telling approach, a memory search continues until ideas are exhausted. An inability to switch idea categories would limit idea generation to one idea theme or idea set. Also, students with LD might take the path of least resistance suggested by Ward (1994) and search only readily available information.

Questions in the A stage of RAN promote a more divergent thinking process encouraging a knowledge transforming approach (Scardamalia & Bereiter, 1987) to idea generation. What-How questions are intended to help the individual think of alternate ways of using an object by thinking about the object and how it may be used or manipulated. Who-How questions direct the individual to think about different people that might use the object and how those individuals may use an object. Also, questions in the A stage of the strategy might extend memory searches. Research has shown that extending memory searches increases flexible thinking in children as they worked through open ended tasks (Runco, 1986). Both sets of questions are intended to facilitate a more divergent thinking process by explicitly directing the learner to switch idea themes, extending deeper memory searches of semantic categories (Rietzschel et al., 2007), and acting as cues to focus student attention on relevant information (Ge & Land, 2003).

N stage. Note and list my ideas is the last step in the RAN strategy. In this stage students review notes they have written down during the idea generation process. Reviewing key words,
phrases, and previously generated ideas could result in additional memory searches of previously searched idea themes, searches of different idea categories, or construction of new cues which initiate further memory searches. Marzano et al. (2001) state that cues are explicit reminders that can trigger memories. Signal words used as procedural prompts to help students generate questions promoted increased comprehension for students with LD (Rosenshine, et al. 1996). It is possible that some words in student notes would act as cues or signal words and promote additional memory searches of new idea categories or deeper searches of previously searched idea categories. These actions might also promote improved ideational flexibility. According to Guilford (1967), flexibility is a crucial element in the idea generation process. Any practice which promotes ideational flexibility should increase idea generation fluency.

**RAN Materials**

During instruction, support materials were used to enhance learning and strategy acquisition. Prior to each lesson, instructional materials specific to each lesson were set aside so that they could be presented in an orderly manner that enhanced lesson presentation. Not all supports were introduced in each lesson. Materials required for administration of lessons were as follows:

1. RAN progress monitoring chart
2. RAN mnemonic chart
3. Self-statement chart
4. Learning strategies contract
5. RAN Graphic Organizer

Five separate lessons were used to teach the RAN strategy. Each lesson session was approximately 45 minutes long. SRSD instruction is recursive and lesson can be repeated if the
student demonstrates a need for additional instruction at any given point. Lesson four only required approximately 20 minutes so each lesson four was automatically repeated during one instructional session. During instruction, pre-written scripts with checkpoints were used to present a particular lesson. As content was covered each completed checkpoint was marked to ensure that lesson content was covered. In the following section, the purpose of each lesson and major themes and practices are discussed. For a thorough description of each lesson, refer to the RAN lesson plans. Detailed lesson scripts and materials for all five lessons can be found in Appendix A.

**RAN Lessons**

**Lesson one.** The purpose of the first lesson was to develop the student’s background knowledge (introduce and explain terms, etc.) and introduce the RAN strategy. The student was told they were going learn a strategy to help them think of a lot of ideas and that learning the strategy was similar to playing a game which would be fun to learn. Support materials for RAN were introduced in lesson one and the tone for future lessons was established. The student began learning the RAN mnemonic.

For the first lesson only, the student was told that they would be learning a strategy that would help them think of a lot of ideas for writing or for other tasks that might require them to think of ideas for completing an assignment for their teacher. Students were told that learning the strategy was similar to a game in which they would be asked to think of as many possible uses of an object as they could. The instructor introduced the prompts (only during instruction, not in any other phase of the study) in the following manner:

“In this game I am going to name an object. It will be your job to tell me a lot of different ways that object could be used. Any object can be used in a lot of different ways. For
example, think of a string. What are some of the things you can use a string for? Here the student tries to think of ideas. The instructor tells the student those are good ideas. The instructor states, “I was thinking you could use string to attach a fish hook, jump rope, hang clothes on, pull down shades on a window.” The instructor should not duplicate ideas given by the student. The instructor states, “Those are all good ideas and there are probably lots more. I can see you understand how we play this game, so let’s start. Remember, think of all the different ways you can use the object I name.”

Next, the student reviewed an idea list they had generated in response to a baseline prompt. The number of ideas generated was charted on the RAN graphing sheet. The instructor explained that they had only generated a few ideas but with practice and using the RAN strategy they would be able to develop improved idea lists. The instructor and student developed an idea generation goal to work for when they used the RAN strategy in the next lesson. At the end of the lesson, a learning contract was developed and signed by the student and instructor.

**Lesson two.** In lesson two, as in all subsequent lessons, the student orally practiced and memorized the mnemonic. The instructor then modeled by thinking out loud how to use RAN for generating ideas and modeled the use of support materials such as self-statements during the process of generating ideas. The student wrote personal self-statements that were used to reinforce strategy use in later lessons. Next, the student added to the prompt reviewed in lesson one and graphed the new idea list on the RAN graphing paper. Student and instructor again decided on an idea generation goal for the next lesson.

**Lesson three.** In lesson three, the student and teacher collaboratively generated a list of ideas in multiple categories using the RAN strategy. The student continued to memorize the RAN mnemonic and graphed his or her work at lesson’s end so they could see the progress they
were making. The student was reminded that with more practice they would get better at generating idea lists. At the end of the lesson the student graphed the number of ideas in their list on the graphing paper.

**Lesson four.** In lesson four the student continued to practice generating ideas using the RAN strategy. The focus of this lesson, however, was to teach the student how to construct a note sheet they could independently use to help them generate ideas. The notes page could be used by the student to work through RAN strategy stages using questions in each stage to facilitate additional cues to initiate deeper and more diverse memory searches. The student was told that they would not always have a graphic organizer with them but they could use one that they constructed in class. The instructor modeled how to construct a notes page by orally working through the strategy. As the instructor moved through the strategy, he wrote down each step of the strategy stage (R, A, N) and notes for each set of questions specific to each stage. For instance, in the A stage of the strategy, the instructor wrote down What-How and Who-How as reminders (see lesson four in Appendix A) and then talked out loud as he wrote down the answers to the questions he asked. Lesson four was repeated twice during the 45 minute session and the student was reinforced for reaching their idea generation goal. The student should have learned the mnemonic RAN by this lesson.

**Lesson five.** In lesson five, the student independently used the RAN strategy for generating a list of ideas that were appropriate to and answered the prompt. Students constructed their own organizer and generated an idea list which reached their individual pre-set idea list. Each student was told that if they reached their idea generation goal they could go back to their classroom. The student was asked to remember what they had learned about generating ideas and to use the RAN strategy when they had to generate ideas for an assignment. The learning
contract was completed and signed by the special education teacher.

**Note taking.** During the instruction phase of the study, the instructor modeled how to create notes using the RAN strategy. Note taking was designed to provide a structured method of generating a greater number of ideas. Over the course of instruction, the student learned how to use this skill to facilitate idea generation as evidenced by increased number of ideas produced in response to prompts. The RAN notes were intended to help organize the student’s thinking, record generated ideas, and to help initiate further cues for generating more thorough memory searches. During post-instruction assessments, students were required to independently produce RAN notes if they wished to use them. As discussed later in the Results section of the paper, notes pages where utilized to help determine which stages of the strategy were used to generate ideas which had been scored as legitimate ideas.

**Treatment Fidelity**

Two steps were taken to ensure treatment fidelity. The instructor had a checklist for each lesson containing step-by-step instructions and scripts for each lesson. As a step was completed during the lesson, the instructor checked off that step. Each instructional session was tape recorded. A graduate student, trained by the first author, was be provided with detailed lesson plans. The graduate student randomly selected one third (Lienemann & Reid, 2008; Reid & Lienemann, 2006) of the completed lessons and evaluated them using a checklist for the lesson being evaluated. The graduate student marked each step of the lesson completed. Session integrity was computed by dividing the number of lesson components taught by the total number of components and multiplying by 100.
Experimental Design

Single-subject Design Studies

**AB design.** Single-subject research is based on a repeated measurement of a behavior across at least two experimental conditions, baseline (A) and intervention phases (B). Baseline (A phase) is the condition without the intervention present while the phase when the intervention is implemented is the experimental (B phase) condition (Gast, 2010; Kazdin, 1978; Tawney & Gast, 1987). The AB design is a time series design and is the most basic quasi-experimental single-subject research design. The dependent variable is measured again and again under the A phase until trend and level are stable. Next, the B phase begins and target behavior is constantly measured. It is assumed that any changes in the target behavior are due to the intervention. However, although the behavior change is likely due to the intervention it is not proven that the behavior change was due to the introduction of the intervention until at least three replications of change are documented. According to Tawney and Gast (1984), the repetition of the baseline and treatment phases is the foundation of single subject research and all single-subject designs are an extension of the A-B design.

**Multiple baseline across participants design.** One variation of the basic A-B design is the multiple baseline across participants design. This single-subject design introduces the independent variable sequentially to subjects who have similar characteristics or, as in the case of this study, have been identified as having similar academic skill deficits or learning needs. In a multiple baseline across participants (at least three) design the effectiveness of the independent variable is determined by its inter-subject effect on the dependent variable across different tiers (participants).
Five or more data points (in some cases fewer data points are acceptable) are collected in the baseline condition until a stable level and trend in the direction opposite the hypothesized direction are demonstrated (Horner et al., 2005). Once an acceptable baseline is determined the intervention is implemented. The behavior of the other participants continues to be intermittently monitored under baseline conditions until the first participant reaches a predetermined criterion level of performance. The intervention is then implemented with the second participant and the process of systemic and sequential introduction of the intervention is repeated with all ensuing participants.

Internal validity. The question of internal validity asks if the intervention and only the intervention is responsible for behavior change. Internal validity is achieved when it is shown that an intervention has an effect on the dependent variable and the effect is replicated within the study (Tawney & Gast, 1987). Single-subject research designs provide experimental control for most threats to internal validity. By controlling for these threats, single subject design studies allow researchers to determine if there is a functional relationship between the independent and dependent variable.

Experimental control with a multiple baseline across participants design is demonstrated by collecting data across all participants during baseline, introducing the intervention to one individual, and maintaining baseline conditions with other pre-intervention participants (Horner et al., 2005; Gast, 2010; Tawney & Gast). Commonly three replications are needed in order to establish a functional relationship between independent and dependent variables. Replications are across at least three participants when using a multiple baseline across participants design (Horner et al.).

For this study, prior to instruction, a stable level and trend was established by collecting
data in response to Alternate Uses prompts. Prior to instruction, students received a minimum of three prompts until a stable baseline performance was established. Student number one received three baseline prompts, the second student received at least five prompts, and the third student to receive instruction received a seven prompts during baseline. Instruction for the second student did not begin until instruction was completed for the first student and so on. Baseline probes for the third student continued up to the beginning of instruction for this student. Approximately one week following instruction, after post-instruction, students one and two received one prompt to determine maintenance. All responses were tape recorded and transcribed for all assessment sessions and lessons during the intervention.

Analysis

Visual inspection procedures (level and trend during baseline, intervention, post-intervention, and maintenance phases) were used to evaluate effects of intervention on fluency ideation (Horner et al., 2005; Tawney & Gast, 1984). Percent of non-overlapping points (PND), one of the most commonly used methods of judging treatment effect in single-case research, was used to evaluate treatment effect on the idea generation performance of participants in the study. PND (Scruggs, Mastropieri, & Casto, 1987) is the percent of data points in post instruction phases of a treatment that exceed the highest data point in the baseline phase of the treatment. PND values of 90% and above represent a large effect, a medium effect is considered 70 – 90%, and 70% percent or lower is considered a small effect. Less than 50% indicates no effect (Gast, 2010). PND is not an effect size. It is the percentage of treatment data points in any given treatment phase that indicates improved performance over the highest score observed in the baseline condition of the study.
Typically, PND is calculated by using data points on a graph. A line is drawn across the graph at the highest data point during baseline. The number of data points in following conditions is counted. If all post-baseline points are above the highest baseline data point, PND is 100%. If there are, for example, 10 data post-baseline data points and eight of those points are above the highest baseline point, PND would be 80%. PND is an indication that the intervention had an effect and how confident the researcher can be about the strength of an effect. PND is not an effect size.

A secondary analysis using mean changes and standard deviation changes by intervention stage (Lane, et al., 2007; Mason & Shriner, 2008) was conducted on ideation fluency. Changes in means and standard deviations can indicate the level of consistency or stability of an individual’s performance within a given condition (Gast, 2010). A graph containing participant scores across baseline, post-instruction, and maintenance conditions provided an opportunity to examine intervention effects on performance as indicated by level and trend of scores. Finally, descriptive data was used to examine treatment acceptability by study participants.
CHAPTER 4

RESULTS

The goal of this study was to evaluate the impact of the RAN (Review key words and phrases, Ask what-how, who-how questions, Now write notes) strategy on idea generation for three seventh students with learning disabilities who were identified by their teachers as having pronounced difficulties in idea generation. Accordingly, a single-subject multiple baseline across multiple participants (Gast, 2010; Tawney & Gast, 1984) research design was used to examine the following hypothesis: Self-regulated strategy development (SRSD) instruction for idea generation would result in improved idea generation fluency. Specifically, it was hypothesized that increasing ideational fluency would increase the total number of ideas generated in response to alternate uses prompts.

The results of this study are presented in four sections. The first set of analyses focuses on the total number of ideas generated. This involved examining baseline, post-instruction, and maintenance phases. In the second section, a descriptive analysis is used to examine the specific components and stages that participants used in idea generation. The final section of the results focuses on experimental and treatment integrity and examines treatment fidelity, inter-rater reliability, and treatment acceptability.

The most frequently recognized measure in single-subject research is percentage of non-overlapping data (PND) (Rogers & Graham, in press). PND was used to evaluate the effect of the treatment on the idea generation performance of study participants. Effects of PND are considered large (>90%), medium (70% - 90%), or small (50% - 70%) effects (Gast, 2010; Scruggs & Mastropieri, 1998; Scruggs et al., 1987). Level and trend data obtained by constructing graphs are used frequently in single-subject research and can provide a visual
representation of participant performance. Changes in standard deviations and means are often used to analyze performance stability and consistency. Descriptive analysis can be used to evaluate the impact of a treatment on participants or to determine how study participants actually felt about the intervention.

**Instruction**

During instruction, lessons were delivered in a one-to-one format. Instruction for Thomas and Alex took place in a small eight by ten room which served as the video library of the school library. Students and instructor sat at two side-by-side desks during RAN lessons. There were no interruptions or distractions during any lesson for Alex or Thomas. Instruction for Rachael took place in her special education resource room. The room was divided in half by a large partition. One section contained six individual student desks and one fold out table. The other half of the room had a large round table which was used for group projects. Lessons for Rachael took place on the fold out table in the back half of the room. There were no interruptions or distractions during any of Rachael’s lessons.

Instruction included five lessons and provided opportunities for repeating lessons if needed. Lesson four was delivered twice in the same instructional session for each student. During the first lesson three sessions, Alex was sick and very nauseous so the lesson was terminated and repeated the next day. Alex repeated lesson 4 a third time before moving on to independent practice. Rachael repeated lesson 5 once. Thomas did not repeat any lesson.

Once students demonstrated they had acquired skills being taught (independently generating a predetermined idea generation goal) they moved on to post-instruction. Post-instruction consisted of three prompts delivered on three consecutive days. Maintenance prompts were administered one week after the last post-instruction prompt for Thomas and
Rachael. Time restrictions prevented giving a maintenance prompt for Alex. Prompts delivered during baseline, post-instruction, and maintenance were delivered using the same protocol (see Appendix D). All prompts were administered in the settings where the students received instruction.

**Analysis of Total Number of Ideas**

The primary dependent variable used to judge the effect of the intervention was total number of ideas (fluency) generated in response to an alternate uses prompt (i.e., Tell me all the different ways you can use a brick).

**Baseline phase.** During the baseline phase of the intervention a minimum of three data points were used to determine stability or trend in the data (Gast, 2010; Tawney & Gast, 1984). In order to determine individual student trends and stability at baseline, Thomas received three baseline alternate uses prompts, Rachael received five prompts, and Alex received seven alternate uses prompts (see Figure 1). During baseline, all three students seemed to have difficulty generating ideas in response to an alternate uses prompt. Thomas generated the most ideas for a given prompt with 6 ideas on the first baseline prompt. Subsequently, Thomas was only able to generate 3 ideas on each of his next two baseline responses. Thomas had an average of $M = 4.0$ ideas with a standard deviation (SD) of 1.73 during baseline (see Table 2). His first prompt response with 6 ideas generated was atypical of all baseline phase prompts during the study. Rachael generated 4 ideas on her first baseline prompt but could only generate 1, 2, 3, and 1 ideas in response to the next four alternate uses prompts. Rachael scored $M = 2.20$ ideas, with a SD of 1.30 during baseline. Alex had the most difficulty generating ideas during baseline. He generated only 1 idea in response to his first three prompts, 3 ideas for the next three prompts, and 2 ideas in response to his last baseline prompt. Alex scored $M = 2.0$ ideas generated in
response to baseline prompts with a SD of 1.00.

Figure 1. Total Number of Ideas Generated
Table 2

Total Ideas Generated – Means and Standard Deviations (SD)

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline Mean (SD)</th>
<th>Post-instruction Mean (SD)</th>
<th>Maintenance Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas</td>
<td>4.00 (1.73)</td>
<td>3.33 (0.58)</td>
<td>5.00 (0.00)</td>
</tr>
<tr>
<td>Rachael</td>
<td>2.20 (1.30)</td>
<td>6.67 (2.08)</td>
<td>9.00 (0.00)</td>
</tr>
<tr>
<td>Alex</td>
<td>2.00 (1.00)</td>
<td>4.67 (1.16)</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>2.47 (1.41)</td>
<td>4.89 (1.90)</td>
<td>7.00 (2.83)</td>
</tr>
</tbody>
</table>

Post-instruction phase. Post-instruction results were mixed. Thomas generated 4, 3, and 3 ideas on his post-instruction prompts. None of his three responses were higher than his first baseline response of 6 ideas. Thomas’s baseline mean of M = 4.00 (SD = 1.73) was higher than his post-instruction mean of M = 3.33 with low variability during post-instruction (SD = 0.58). This would indicate that the intervention was not effective for Thomas and that instruction had no impact on his ability to generate ideas. However, it should be noted that his first baseline score of 6 ideas was not repeated during the rest of the intervention. Rachael, however, did show improvement in total ideas generated. She generated 9, 6, and 5 (M = 6.67) ideas in response to post-instruction prompts. Rachael had the highest variability with a 200% increase (SD = 2.08) in ideas generated. All three of her responses were greater than her highest baseline response of 4 ideas. Alex also showed improvement. He generated 6, 4, and 4 (M =
4.67) ideas in response to post-instruction prompts. Alex showed lower variability across baseline and post-instruction phases with a SD = 1.00 and SD = 1.16 respectively. All of his post-instruction responses were higher than his highest response of 3 ideas during the baseline phase of the intervention.

**Maintenance phase.** Thomas generated 5 ideas in response to a maintenance phase prompt. This was higher than any of his responses during baseline or post-instruction with the exception of his first baseline prompt response of 6 ideas. Rachael scored 9 ideas generated in response to a maintenance phase prompt. This equaled her highest performance 9 ideas generated on her first post-instruction prompt during the post-instruction phase of the intervention. Due to end of school year, Alex did not receive any maintenance prompts.

**Summary.** Before proceeding to the post-instruction phase, all three students demonstrated mastery of the strategy by reaching individual goal levels of performance in independent performance during the instructional phase of the intervention. Two students maintained increased levels of performance during post-instruction phases above baseline scores. Group means suggest that overall, students improved with scores of M = 2.47 at baseline, M = 4.89 at post-instruction, and M = 7.00 at maintenance. Group variability was low at baseline (SD = 1.41) and post-instruction phases of the intervention. Level and trend data points indicated Thomas did not benefit from instruction. Rachael and Alex improved their performance in ideation in generating idea lists for alternate uses prompts. PND for both Rachael and Alex was 100% PND indicating a large effect. However, PND for post-instruction and maintenance phases of the treatment for all students as a group was 63% PND indicating a small effect.

It should be noted that during the post-instruction phase of the study, all three students showed a decreasing trend from the first post-instruction prompt to the third post-instruction
prompt. This decrease was not due to specific prompts. All prompts were counterbalanced to ensure against this occurrence. Each student received a different prompt than their peer for each post-instruction and maintenance session. Even though students were taught to criterion levels before proceeding to post-instruction they were not taught to fluency. More practice would be necessary in order to maintain initial post-instruction gains, possibly as many as ten sessions rather than five sessions.

**Origin of Ideas by Strategy Stages**

A descriptive analysis of specific components and questions in stages inherent in the RAN strategy was used to determine which aspects of the strategy were used by students to generate ideas. Table 3 illustrates the number of ideas generated by students using specific components of R (Review key words and phrases), A (Ask Wh-questions), and N (Now add your notes).
Table 3

*Total Ideas Generated by Strategy Stage*

<table>
<thead>
<tr>
<th>Strategy Stage</th>
<th>W H Questions</th>
<th>Thomas</th>
<th>Rachael</th>
<th>Alex</th>
<th>Total Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PI</td>
<td>M</td>
<td>PI</td>
<td>M</td>
</tr>
<tr>
<td><strong>R</strong> – Review key words and phrases</td>
<td>Ask What Questions</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Ask What How Questions</td>
<td>What-How Questions</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ask Who How Questions</td>
<td>Ask Who-How Questions</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Now write notes</td>
<td>Check my notes</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Other “out of the box” ideas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Ideas</strong></td>
<td></td>
<td>10</td>
<td>5</td>
<td>14</td>
<td>9</td>
</tr>
</tbody>
</table>

R = Initial RAN strategy stage; Ask = Second strategy stage; Now = Third strategy stage; PI = Post-instruction ideas; M = Maintenance ideas; Numbers (e.g., 8, 4) represent ideas generated during a strategy stage in a PI or M phase.
**Review key words and phrases.** Students’ prior knowledge about the prompt object and identification of key words or phrases to act as a cue to initiate more extensive and thorough initial memory searches was stimulated in the first stage of the strategy, R: Review key words and phrases. Data indicated that this first stage was not effective for Thomas. Thomas generated 15 total ideas during post-instruction and maintenance. Even though Thomas generated 80% (12) of his ideas by answering questions in the R stage, his post-instruction mean score of $M = 3.33$ was less than his baseline score of $M = 4.00$.

Analysis indicated, however, that Rachel generated 23 total ideas during post-instruction and maintenance. Rachael produced 43% (10) of her ideas during the R stage of the strategy. Her post-instruction score $M = 6.67$ ideas improved over her baseline score of $M = 2.27$ ideas. Alex also improved his baseline score of $M = 2.00$ ideas to $M = 4.67$ ideas at post-instruction. Of 14 post instruction ideas generated, 43% (6) of his ideas were generated during the R stage of the strategy.

**Ask W-H questions.** The RAN strategy taught students to ask two forms of questions, What – How, and Who – How questions, during the second RAN stage of the strategy, A: Ask W-H questions. Eighteen ideas (35%) of 52 total ideas were generated during the A stage of the strategy. Asking What – How questions produced 7 ideas. Thomas, Rachael, and Alex generated 1, 2, and 4 ideas respectively from asking What-How questions. Who – How questions generated 11 ideas. Thomas, Rachael, and Alex generated 1, 6, and 4 ideas respectively.

Results indicate the A stage of the strategy was not effective in improving Thomas’s ability to generate additional ideas. Thomas only generated 2 additional ideas during the A stage. The data indicates that Rachael and Alex improved their idea generation performance by
using questions in the A stage. Rachael produced 8 (35%) additional ideas and Alex produced the highest percentage of his ideas (57%).

**Now add your notes.** The N, Now add your notes stage in RAN, was not effective for Thomas and Alex. Thomas generated 1 idea and Alex failed to generate any ideas in this final RAN stage. Rachael, however, benefited from the N stage by writing additional 5 ideas.

**Summary.** A total of fifty-two ideas were generated overall using the RAN strategy for idea generation during the post-instruction and maintenance. Of these 52 ideas, 54% (28) of total ideas where generated in the first RAN stage, 35% (18) of total ideas were generated in the second RAN stage, and 11% (6) of total ideas were generated in the final RAN stage. Thomas generated the least number of total ideas overall during the intervention. Further, as shown on Table 3, he generated the least number of ideas using the strategy beyond the first stage. In contrast, Rachael and Alex generated more ideas in the last two RAN stages (Ask W-H questions and Now add your notes).

**Treatment Fidelity**

Two steps were taken to ensure treatment fidelity. During instruction, the instructor used detailed lesson plans and checked off each step of the lesson plan as they were completed. Next, a doctoral student was given a set of lesson plans, listened to 50% of the recorded lessons (randomly selected by Microsoft Excel software) and checked off completed steps for these lessons. The doctoral student calculated treatment fidelity by dividing the total number of completed lesson plan steps by the total number of lesson plan steps and multiplying by 100%. Treatment fidelity recorded by the instructor was 100% of all steps completed and 98% of the recorded lesson steps were completed.
Inter-rater Reliability

Two scorers independently scored all student responses for total ideas and idea categories. In order to calculate inter-rater reliability, the total number of agreements was divided by the total number of ideas and multiplied by 100%. Inter-rater reliability for total ideas generated was 93.2%. Because idea categories were not predetermined, idea categories were determined using a consensus basis between the two scorers. Scorer consensus for idea categories was 100%.

Treatment Acceptability

Results from the treatment acceptability questionnaire indicated that Thomas, Rachael, and Alex were positive about the RAN strategy. All three students demonstrated that they felt that the RAN strategy had helped them think of more ideas. Thomas stated, “Yes, it’s easier to come up with ideas and actually know what they are used for.” Rachael said, “It sort of did, but I still have problems coming up with ideas.” Allen also said the strategy helped him think of ideas. He stated, “Yes, it helped me learn some more, like help me get more ideas down. It can help me in one of my projects I need to do, an essay to.”

When asked what they thought helped them the most, all three students indicated the A component of RAN (What – How, Who – How questions) was the part of the strategy that helped them most. When asked if they thought the strategy could help other students think of ideas, Rachael and Allen felt the strategy might help other students. Allen said, “If they use it, it can help them like do better in school work.” All three students stated they would not change the strategy.
CHAPTER 5
DISCUSSION OF RESULTS

Students with learning disabilities (LD) often have difficulty generating ideas and content across academic areas. Skill deficits related to knowledge storage, retrieval, and reorganization of knowledge inhibits the ability of these students to access and make the most of their true memory skills (Swanson & Saez, 2003). Deficits in memory retrieval can be due to an inability to activate and sustain memory searches or perform a deeper more thorough analysis of memory. Either can result in missing information that might be crucial to fulfilling a task requirement (Craik & Lockhart, 1972; Englert & Raphael, 1998). Another difficulty faced by students with LD can be an inability to efficiently access prior knowledge. When presented with a task, students who cannot first access prior knowledge would have problems generating ideas (Nijstad & Stroebe, 2006). Difficulties with idea generation may also be attributed to an inability to inhibit irrelevant information which acts as a constraint to generating specific ideas (Passolunghi & Siegel, 2004).

Swanson and Saez (2003) suggest instructional procedures should consider these deficits and the difficulties they present for students with LD. Further, Swanson and Saez suggest that instructional procedures should attempt to tap into unused memory abilities of students with LD. The goal of this study was to design a portable instructional strategy, based on findings of the literature review, which would address those deficits. The RAN (Review key words and phrases, Ask W-H questions, Now write notes) strategy was designed to consider memory deficits experienced by students with LD and provide a structured approach to instruction which would help ameliorate memory deficits and facilitate use of the student’s true memory abilities.

The purpose of this study, then, was to examine the effect of a researcher designed
strategy, RAN, on the idea generation performance of students with LD when they are asked to generate ideas for alternate uses prompts. Primarily, this study examined the effect of SRSD instruction for idea generation on the ideational fluency performance of students with LD. It was hypothesized that self-regulated strategy development (SRSD) instruction for idea generation would increase ideational production by facilitating ability to access prior knowledge, promoting deeper more thorough memory searches and by improving students’ ability to switch idea categories or idea themes.

While effects of SRSD instruction have been well documented in the literature, no study has investigated the effect of SRSD strategy instruction on idea generation performance of students with LD. Next, the three research questions posited in Chapter 1 are addressed first followed by discussions of limitations of the study, treatment acceptability, and implications for future research.

**Idea Generation Fluency**

The first research question asked if SRSD instruction for idea generation for students with LD would improve ideational output or idea generation fluency. Data indicates that strategy instruction did promote an increase in idea generation performance in two of three students. During baseline, although students were given a pencil and the prompt was provided on a piece of paper and placed in front of them, no student made any attempt to write notes or use any plan to help generate an idea list. Students simply thought about the prompt for a short time and then recited their idea list in a knowledge telling (Scardamalia, & Bereiter, 1987), convergent thinking approach to fulfilling the task requirements.

The number of ideas produced by the students during baseline was not unexpected. This knowledge telling approach to idea generation is consistent with the literature and was indicative
of an initial memory search which was not a deep or thorough memory search (Craik & Lockhart, 1972). Further, an inability to access prior knowledge could result in retrieval failure which would affect initial idea generation performance (Nijstad & Stroebe, 2006). An inability to access extant knowledge would also prevent any new knowledge construction and ultimately hinder idea generation performance (Baughman & Mumford, 1995). The literature also suggests that once this initial memory search was conducted and concluded, it was unlikely that another search would be initiated unless the student received a prompt or cue to continue or initiate another memory search.

Overall results for the idea generation were mixed. Data suggests that the RAN strategy did in fact promote increased production of total ideas for two of the three student participants. The data showed that idea generation for Thomas did not improve indicating he did not benefit from using the RAN strategy. However, data also indicated both Rachael and Alex did improve idea generation performance by generating more ideas in response to post-instruction prompts.

These results were somewhat unexpected. During the baseline and instruction phases of the intervention, Thomas had the least amount of difficulty generating ideas. He had the highest mean number of ideas (M = 4.00) of all three students during baseline. However, during post-instruction, he had difficulty with task persistence and with generating ideas for his responses. His post-instruction mean decreased to M = 3.33. Interestingly, Thomas’s maintenance response was five ideas, the most of any prompt except for the first baseline prompt.

Thomas did have more difficulty with writing mechanics than the other two students in the study but that did not inhibit his ability to generate ideas during the instructional phase of the study. Thomas’ teachers did not know of any change or event in his personal life that was affecting his performance at school. It might be important to note that his demeanor seemed to
change from an easy going student during baseline and instruction to a more quiet, serious individual during post-instruction phases. However, that is a subjective observation and no determination can be made from data as to why his performance declined after instruction.

Data indicated that Rachael did improve her idea generation performance with an increase over her baseline performance by 200%. Rachael’s baseline standard deviation (SD = 1.30) was less than her post-instruction standard deviation (SD = 2.08) indicating more variance in prompt responses. Rachael’s demeanor was consistent throughout all phases of the intervention. She was aware that she had difficulties “coming up with ideas” and worked hard to learn the strategy. Rachael was always positive and was a pleasure to work with. She appeared to be highly motivated during instruction and this may be an indicator in part to her success in improving her idea generation performance. Motivation is an important variable that can impact an individual’s creativity and facilitate idea generation (Amabile, 1983; Nickerson, 1999).

Data also indicated that Alex benefited from using the RAN strategy. Of the three students, I initially felt that Alex would benefit the least. Before and during baseline, Alex would not talk to me or even acknowledge me in the classroom. Conversation with Alex during baseline was confined to reading the prompts as directed on the protocol sheet and reciting idea lists. During instruction, however, Alex became increasingly engaged in the lessons and was very goal oriented. He worked hard to hit his idea generation goal for each lesson and enjoyed graphing his ideas at the end of each lesson. He more than doubled his performance from a baseline mean of M = 2.00 to a post instruction mean of M = 6.67. Alex’s standard deviations scores during baseline and post-instruction show variability was low (SD = 1.00 and SD = 1.16).

Idea Generation by Strategy Stage

The second research question asked what the origins of generated ideas were by strategy
stage. Data reflects previous findings on total ideas and total idea categories. If strategy instruction had an effect, several things should have taken place. Memory searches should have been deeper and more thorough, more idea categories would have been activated, and information retrieved would have been more efficiently organized. A descriptive analysis of origin of ideas by strategy phase indicates that memory searches were more thorough and did facilitate increased idea generation ability for Rachael and Alex but that Thomas did not benefit from strategy instruction.

**R stage.** Review key words and phrases was designed to activate and extend initial memory searches and provide additional cues to initiate more thorough memory searches. Although it cannot be definitively stated, given the large increases in total ideas for Rachael and Alex, it would seem intuitive that the R component of the strategy might have helped promote deeper and more thorough initial memory searches. Both students generated approximately forty per cent of their ideas during this stage of the strategy. For Thomas, however, the number of ideas generated during all stages of the strategy was actually less than the total number of ideas he generated before instruction.

**A stage.** The A (ask who-how; what-how questions) component of the strategy was designed to promote both idea generation flexibility and fluency. The purpose of questions during the A stage of the strategy was to promote divergent thinking which would facilitate the students’ ability to more efficiently switch idea themes or idea categories. The A stage of the strategy did seem to extend or deepen memory searches and provide cues for additional memory searches along more idea themes or categories. Rachael generated over half of her ideas in the A and N stages of the strategy. Data indicates similar results for Alex. Alex generated eight of 14 ideas during post-instruction in the A stage of the strategy. This would indicate that for Rachael
and Alex, after the initial memory search during the R stage of the strategy, additional cues from self-questions were effective in prompting over 50% of the total ideas generated during post-instruction and maintenance phases of the intervention.

**N stage.** Now add your notes was designed to promote flexible thinking by using ideas generated from previous stages of the RAN strategy as cues to initiate additional memory searches. It was hypothesized that reviewing written notes produced by the student would initiate further memory searches and aid the student in generating additional ideas. Data indicates that the N stage of the intervention was the least effective stage in generating additional ideas. Rachael was the only student that seems to have benefited from the N stage by generating five additional ideas past the A stage. Thomas generated only one idea in this stage and Alex did not generate any ideas in the N stage of the strategy.

**Summary.** Data indicates that Rachael and Alex benefited from SRSD strategy instruction for idea generation. After receiving instruction, these two students were able to increase the total number of ideas over baseline performance. For Rachael and Alex, data indicates improved idea generation fluency in idea generation. Thomas did not benefit from the instruction. The most effective stages of the RAN strategy were the R and A stages of the strategy and the least effective stage was the N stage.

**Treatment Acceptability**

The third research question was “Will participants feel that the RAN strategy instruction helps with idea generation?” All three of the students indicated they felt the strategy helped them think of ideas. Even Thomas stated that it was easier to come up with ideas and know what they are supposed to be used for. Rachael felt it helped her but she still had problems generating ideas. Alex said the strategy could help him on a project and also on an essay. The data also
reflects what the students stated, the A stage of the strategy helped them the most. None of the students suggested any changes to the strategy.

**Limitations**

**Replication**

Even though results for two students were promising, any positive results need to be examined within the context of limitations of the study. Single subject research practice recommends at three replications in a single-subject research study (Gast, 2010; Tawney & Gast, 1984). Replication of results indicates a functional relationship between dependent and independent variables. A functional relationship between instruction and results, therefore, was not obtained because only two replications were obtained during this study. The study could have used more participants but time restrictions prevented instruction of more than three students.

Also, Thomas illustrated some of the difficulties often experienced when teaching students with special needs. Thomas outperformed Rachael and Alex during baseline and instruction. During post-instruction, however, Thomas’s demeanor changed and his performance dropped noticeably. Neither the researcher nor the teachers knew why this happened. SRSD instruction is recursive but end of school year time restrictions prevented repetition of lessons four or five. Thomas did, however, improve over post-instruction scores at the maintenance phase of the study. If lessons had been repeated, Thomas’s scores might have improved during post-instruction.

**Participants**

One critical variable which defines single subject design studies is the participant description. Horner et al. (2005) state “single-subject research requires operational descriptions
of the participants, setting, and process by which the participants were selected”. While the
the setting and process of selection were discussed and a specific disability was determined,
district policy did not allow an adequate description of the instruments that were used to make
disability determinations for these students. As a result, participant descriptions were
inadequate.

Generalization

There was no attempt to teach the students to generalize any skills learned from
instruction for idea generation to another setting. It must be recognized that students with
learning disabilities may experience problems knowing when, where, and how to use strategies.
Even though results for two of the students were positive, it does not mean that they would use
or even know when to employ any skills they learned during instruction in another school
setting. This shortcoming should be addressed in future studies.

Implications

The results of this study provide initial evidence that SRSD instruction for idea
generation can improve idea generation fluency and flexibility for middle school students with
LD who have difficulty generating ideas. However, it must be noted that students received
individualized SRSD instruction. Teachers might experience difficulties that a researcher does
not have to deal with. Time, classroom, curriculum, or district/school constraints might all play
a part in challenging the teacher if they consider delivering individual strategy instruction to a
student or group of students. The manner in which the student interacts with the teacher
compared to the way they interact with a researcher during instruction could also be a constraint
on instructional delivery.

Future studies need to be conducted with several caveats. First, categories should already
be created with ideas assigned to them. This study provides a starting point for creating idea categories for ideas generated in response to the prompts used in this study but may not be representative of idea categories generated by peers of student participants. Second, studies need to be conducted with more students (with more thorough student descriptions) in order to adequately replicate and validate positive results obtained in this study. Third, studies need to be conducted which examine the effects of instruction delivered by teachers. Finally, this study provided initial evidence that SRSD instruction delivered by a trained instructor in a one-to-one instructional condition improved the idea generation fluency and flexibility of students with LD.

**Conclusion**

This study examined the effect of SRSD strategy instruction for idea generation on the ideational fluency performance of three students with LD. Data indicated improvement in idea generation fluency for two students. One student did not benefit from instruction. During post-instruction, the two students who did benefit from instruction demonstrated idea generation fluency performance above baseline levels of the study. One student, Rachael, continued improved performance at maintenance. The results of this study indicate that students with LD might benefit from strategy instruction for idea generation.

Research shows that idea generation is a complex process and that students with LD often have difficulty with that process. Further, research suggests problems with idea generation for students with LD are due to memory deficits which impact the ability of the individual to store, retrieve, manipulate, and/or organize information/knowledge into new knowledge. Other research postulates that difficulties with idea generation can be due to an inability to access prior knowledge and use it to formulate new knowledge. Whatever the reason, it is well known that for some students with LD, difficulties with generating ideas or content across academic content
areas negatively impact their academic achievement. This study is a first step in developing an instructional tool that might be used to ameliorate or limit the effect of memory deficits on the academic performance of students with LD who have trouble generating ideas. Given the importance of academics and the impact these deficits can have on this student population, it would seem appropriate to conduct further research in this area.
References


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APPENDIX A
Lesson Overview

The purpose of this first lesson is to develop the student’s background knowledge and discuss the RAN strategy. The teacher will discuss and describe the RAN strategy parts. The student and teacher will collaborate to discuss generating ideas using the RAN strategy.

Student Objectives

The student will orally state the steps of the RAN strategy. The student will generate ideas for questions in the RAN strategy. The student will begin to memorize the RAN steps and questions.

Materials

2 RAN mnemonic charts (one for the student’s folder and one for the student to take home), learning contract, paper, pencils, lined paper.

Set the Context for Student Learning

Tell the student that you will be working with them to learn a new strategy. This strategy will help them generate more ideas that can be used for class assignments or in situations where they might need to generate lots of ideas (e.g., writing assignments in any of their classes, discussion groups, games, etc). Tell the student that they are going to learn a different way to think. Say, “You will learn how to think of more ideas and how to think flexibly. In other words, you will be able to think of ideas from another’s point of view.”

Tell the student that they will be learning a trick for generating ideas, this trick is somewhat like a game. “In this game I am going to name an object. It will be your job to tell me lots of different ways that object could be used. Any object can be used in a lot of different ways. For example, think of a string. What are some of the things you know about string and how it can be used? Let the student try to think of ideas and tell the student those are good ideas. The instructor states “I know that string can be used to attach a fish hook, jump rope, hang clothes on, or used to pull down shades on a window.” The instructor should not duplicate ideas given by the student. The instructor states “Those are all good ideas and there are probably lots more.”

Commitment to Learn the Strategy

Ask the student to “sign up” to learn the strategy. Give the student a learning contract and have them complete it and sign it. After they have signed the contract, you sign it. Be sure to tell the student that you are committing to doing your best in teaching them the RAN strategy.
Develop the Strategy and Self-Regulation

Step One – Develop Background Knowledge and Discuss It

_____ Describe and discuss RAN. Put out the RAN mnemonic chart. Tell them that the RAN strategy makes it easier for them to come up with more and different ideas. Tell them RAN has 3 basic steps:

_____”R” – Review key words or phrases in the prompt. Discuss that in the “R” strategy step you will ask yourself two questions – “What is the topic?” And “What do I know about it?” Note that you did this previously with “string.”

_____“A” – Ask What-How and Who-How questions. Discuss each question:

____ Say, “What are the objects’ properties? Think about the example of string. What does string look like? Does it always look the same, for example, can it be in different sizes and colors?” BE SURE THE STUDENT UNDERSTANDS WHAT PROPERTY MEANS.

_____ Say, “How can the object be used? Note that you discussed some uses earlier. What were some of the things you noted? Can you think of other uses?”

_____ Say, “Think about Who could use this object. For example, a “gardener” can use string.

_____ Say, “Now I need to think, how does a gardener use string? They can use string to tie plants in the garden, to hang birdhouses, to mark the garden plot, etc.”

_____“N” – Note and list my ideas. Say, “We are just discussing this now but it would be helpful to have written some notes to help us remember. The important thing to remember about this step is that we can always add more notes and ideas. We will do this next time.”

_____ Describe and discuss how using RAN can help them generate more ideas. Some students may not be at all familiar with this. Be sure to tell the student that:

_____ A. RAN gives you steps to help you come up with good ideas. The best idea lists include ideas from different perspectives; think outside the box, all ideas are okay. (You will be practicing this with them, so you just want to be sure they have the idea here).

_____ B. RAN can help you think of more ideas because it helps you be flexible in the way you think. That can help you think of more ideas.

Step Two – Collaboratively work through RAN
Collaboratively discuss how to use RAN by working through the steps in order. Use the mnemonic chart as you work.

Say, “Let’s try thinking of ideas using all the steps of RAN. Let’s think about a water hose.” Point to the “R” on the chart, and then write the letter R on a blank lined sheet of paper. Then point to the first question. Say, “Well we know the object is a water hose.” Point to the second question. Say “What do you know about a water hose? Let’s write some notes to help us remember.”

Note: Generate ideas together; the teacher does all the writing for now!

Write simple notes – e.g., green, long - based on what the student and you generate.

Point to and Write the letter “A”

Write “What” then write simple notes – flexible…

Write “How” – water garden, wash car

Write “Who” – my dad

Write “How” – wash deck

Write “N”. Say, “Did we write some notes? Yes, let’s go back and put a check mark by each step of RAN to check what we did.” (Put a check mark by R, each question in A and then N).

Say, “That is how RAN works. We could have thought of more ideas, for example, I just thought about how a firefighter uses a water hose.” Go back adding firefighter to the “Who” and put out fires to the “how” ideas in the notes. Say, “We will practice coming up with more ideas over the next couple of days.”

STEP 3 – Memorization practice

Use the remainder of the session time practicing memorizing the RAN steps and questions. Start with the mnemonics and scaffold to full questions.

First – R – Review
A – Ask
N – Note

When the student has this memorized

Cue - What are the 2 questions in R?

Topic and what I know
What are the 4 questions in A?
Remember What-How, Who-How
What do you need to do with N?
Check and Add
Tell the student that you will test their memory of RAN test next time. Give them a mnemonic sheet to take home for practice.
Lesson Overview

The teacher models how to use RAN for generating ideas. The teacher models the use of self-statements during the process. The student writes personal self-statements. The student will count the number of ideas they generated in an idea generation response that they had produced prior to instruction. They will graph this number of ideas on charting paper. It will be important for the teacher to discuss that although a student may have a only developed a few ideas they will improve with practice using the RAN strategy. The student will revise the number of ideas they can produce in response to a prompt by adding to their previous idea generation response.

Student Objectives

The student will orally say the mnemonic for RAN and state what each letter stands for and state the questions. The student will attend to the teacher’s modeling lesson. The student will write self-statements for the RAN idea generation strategy. The student will evaluate prior performance and revise by adding ideas to their list.

Materials

RAN mnemonic chart, graphing sheet, self-statement sheet, prompt “Tell me all the different ways you could use a Aluminum Can”, student’s typed prior idea list, paper, pencils.

Set the Context for Student Learning

Test to see if the student remembers RAN; do it out loud to save time. It is essential that the student memorizes the strategy and the questions. If the student is having trouble with this, spend a few minutes practicing it. Tell the student you will test them on it each day to make sure they have it.

Develop the Strategy and Self-Regulation

Step One – Model the Strategy

____ EXPLAIN that you will be talking out loud all the steps of completing the RAN strategy. Use problem definition, strategy use, focusing, self-evaluation, coping, and self-reinforcement self-statements as you go. Follow the steps and statements below by working through each letter
of the strategy. Fill in ad lib statements where indicated. Ask the student to help you with generating ideas, but be sure you are in charge of the process. You should write all notes during modeling.

Tell the student that today you are going to generate a list of ideas using their help. Say, “I will use RAN to help me. I will use the strategy steps to generate ideas and write notes.” Review - what should my goal be? To be able to generate a list of ideas that can be used for class assignments like writing essays etc. Remind them that the RAN strategy will make it easier for them to think of more ideas.

“R” Review key words and phrases

Say, “Today we are going to practice how to use this strategy to generate ideas - review what that means if necessary. To do this we have to be creative, we have to think free and think flexibly.” (review what that means if necessary). Lay out a copy of the RAN mnemonic chart. Say, “Today I will show you how to use the RAN strategy to generate ideas.”

Read aloud the practice prompt: “Tell me all the different ways you could use an aluminum can.”

Say, “What is it I have to do? I have to generate a list of ideas that make sense. Remember R in RAN means review key words and phrases. I have to let my mind be free, be flexible. (Pause) Take my time, think about the questions - do I see any words or phrases that gives me ideas? What do I know about this topic? Stop and think about this and good ideas will come to me.” (Pause) Then say: “What do I know about the object? What have I heard about it?”

Model the process for Review key words and phrases by going over the questions to see if the prompt gives you any ideas. (Now - talk out and write notes for your ideas. Be sure to do this by writing “R” with short notes.

What do you know about the object? (Now - talk out loud and write notes for what you know. Be sure to let the students see your notes so they see your idea generation process). “Good I like this idea!”


Say, “The second letter of RAN is A – Ask What-How, Who-How questions. Can I think of any ideas/answers to the question?” Be sure to model 4 or more ideas.

What are its properties (physical properties, color, light, heavy, etc?)
How can the object be used?
Who would use it?
How would they use it?

Model the entire process for answering questions.
(talk out loud and write notes for any ideas you have)
“N” Note and list ideas

_____ Say, “The third letter of RAN is N – Note and list ideas. Well, I wrote notes, now I need to go back and add to my notes.” Go back and model how to add to notes.

Step Two – Model orally generating a list

_____ Say, “I will now show you how to use notes to generate ideas for “Tell me all the different ways you could use aluminum can.”

_____ Using your note list, cross off the notes that directly answer the questions that do not tell how an object can be used. In other words, answers to “what are the properties” and “who could use it?”

_____ Model listing the ideas generated – USE THE NOTES TO HELP YOU. Be sure to model adding another idea. For example, “I just remembered that my grandmother used an aluminum can to bake brown bread. That is another idea I can add while I am giving my list out loud.”

_____ Say, “I am so happy with the ideas I listed. My notes helped me remember and the questions helped me generate new ideas even after I thought I was finished with notes!!”

Step Three – Self-Statements

_____ Ask the student if they can remember the things you said to yourself while generating ideas. Say, -“Note that we don’t always have to think these things out loud; once we learn them we can think in our heads or whisper to ourselves.”

_____ Ask the student to write some things they could say, to themselves, on the self-statement sheet.

This must be along same lines as "What is it I have to do? I have to think of a list of ideas using RAN." – be sure the student uses their own words.

“I can do this.” “Relax, keep an open mind.” “Be flexible, think free.” “Let my mind be free and good ideas will come”. “That’s a great list.” “Good job!”

Step Four – Look at current idea generation behavior

_____ Ask the student if they remember the list of ideas they wrote the other day? Give out one list of ideas generated at baseline. Be sure to select one that will clearly illustrate adding ideas.

_____ Read the list to the student. Count the number of ideas. (You need to have this worked out ahead of time.)

_____ Briefly note the number of ideas and what RAN questions are answered. Note areas (questions) where most ideas are formed.
Note also that even though we have ideas, we might be able to generate more ideas by asking questions. Discuss examples of how they could do this by asking RAN questions.

**Step Five – Graph Current Level of Performance and Set Goals**

Give the student a graphing sheet - ask the student to fill in the graph for the number of ideas they had in their baseline response. Be very positive by reminding them that they are just now learning the trick of generating ideas. Explain that they fill in one space for each idea.

Explain the goal - to generate more ideas. Remind the student that being able to think of good ideas will help them when they need to generate ideas for school assignments. Also, good ideas might help them in some activities where they are asked to come up with ideas and solutions to problems.

Say, “The goal is to have more ideas the next time we use RAN to generate ideas.”

**Step Six – Student revisions**

*Prior to starting revisions, the student and you will set a goal for ideas (from baseline prompt). This must be reasonable and based on what you feel the student is capable of, only two or three more ideas for this lesson. The idea is to help the student set a goal to work for. It is not a criterion number, just a goal that may need to be reset for each lesson and for the individual student.*

Give the student time to write notes on their previous idea list by answering the RAN questions. Be sure to work with the student to generate a list of ideas that are relevant to the prompt and make sense. Tell them notes should be short (one or two words) to help them remember thoughts. Help the student generate more ideas using RAN.

Ask the student to count their new ideas.

Graph the total number of ideas (original and new ones) on the graphing sheet. Ask student, “How many ideas do you have? Do you like these ideas? Congratulate the student on working hard to reach their personal goal. Then fill in graph.

**Wrap-Up**

Remind the student of the RAN test again next time.
Lesson Overview

The student and the teacher collaboratively generate a list of ideas using the RAN strategy.

Student Objectives

The student will orally state the mnemonic for RAN, what each letter stands for, and the questions for each step. The student and teacher will collaboratively generate a list of ideas.

Materials

RAN mnemonic chart, graphing sheet, self-statement sheet, paper, and pencils, practice prompt – “Tell me all the different ways you could use a paperclip.”

Set the Context for Student Learning

Test to see if the student remembers RAN and the questions: do it out loud to save time. It is essential that the student memorize this. If the student is having trouble with this, spend a few minutes practicing it. Tell the student you will test them on it each day to make sure they have it.

Develop the Strategy and Self-Regulation

Step One – Collaborative idea generation – Support It.

Give the student a mnemonic chart, the self-statement sheet, and a blank piece of paper. Put out the practice prompt, “Tell me all the different ways you could use a paperclip.”

Tell the student that during the next couple of lessons you will be generating a list of ideas related to an object and each time, because they have practiced, they will be a little faster and will generate more ideas. Tell them that the goal is to see how many ideas they can generate. This practice will help them generate more ideas and will help them with writing papers and other assignments or activities where they need to come up with ideas.

Ask them to describe times that they have to think of ideas for an assignment or activity. If they do not give you examples, provide some. For example, in a class test for writing an
essay, in a group activity where they solve problems, etc. Tell the student that idea generation is like all activities, with practice and some tricks you can develop a list of good ideas in a short time.

Say, “Today we will use RAN. I will use this blank paper to write notes.” Review - what should the goal - To develop a list of good ideas. Say, “I need to think of different uses for a paperclip.”

_____ Say, “Remember that the first letter in RAN is R – Review key words and phrases.” Refer student to their self-statements for creativity or thinking free. Review key words and phrases to see if they give you ideas. Ask the two questions: What is the topic? What do I know about the object? Ask the student to write “R” and then write notes.

_____ Say, “The second letter in RAN is A – Ask What-How, Who-How questions.” Refer the student to the mnemonic chart if needed. Help the student work through the questions. Ask the student to write “A” and write notes for each question.

_____ Say, “The third letter in RAN is “N.” Encourage and remind the student to start by saying “What is it I have to do here? I have to write notes to help think of good ideas.” “Keep your mind free and be flexible, think outside the box.” Help the student as much as they need to do this, but try to let them do as much as they can alone. Encourage them to use other self-statements of their choice and to use questions to help them to add to their ideas.

**Step Two – Practice listing ideas**

_____ Say, “Remember yesterday I showed you how to use you notes to tell a list of ideas. What do you need to do first? That is right, cross out the answers to the “What” and the “Who” questions. This leaves you with a list of ideas. Do you have other notes and ideas to add?”

_____ Say, “Now tell me your ideas. Be sure to add to the ideas if you think of new ones.” Write the ideas as the student tells them to you.

**Step Three – Graph the idea list**

_____ Have each student graph the idea list. Encourage the student and be sure to find something to praise them for (the job they did, great list, you worked really hard, etc.) and for reaching their personal goal. Let them fill in the graph. Reinforce them for working so hard and tell them next time they will do even better. Be sure to point out their good ideas.

<table>
<thead>
<tr>
<th>Wrap-Up</th>
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<tbody>
<tr>
<td>Help student in setting a personal goal for the next class. Remind the student of the RAN test again next time. <strong>REPEAT THIS LESSON AS NEEDED!!!</strong></td>
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</table>
Lesson Overview

In this lesson, the student continues to practice the RAN strategy for generating ideas. The focus of this lesson is to begin to wean the student off the mnemonic chart.

Student Objectives

The student will generate a list of at ideas and work towards reaching a personal goal for idea generation.

Materials

Graphing chart, self-statement sheet, paper, pencils, practice prompt 4a – “Tell me all the different ways you could use a brick.” Lesson Prompt 4b – “Tell me all the different ways you could use a blanket.”

Set the Context for Student Learning

Test to see if the student remembers RAN. They should have it by now!

Develop the Strategy and Self-Regulation

Step One – Wean off Support Materials

Explain to the student that they won’t usually have a RAN mnemonic chart with them when they have to generate ideas in the future, for example, for classroom assignments. Discuss and model how to write down the reminder at the top of the page. Then tell them this will be easy to do – they have been doing this while writing notes!

R –
A –
N –

Then make a space on the paper for question cues and ideas for each part.

Step Two – Collaborative idea generation– Support It
____ Ask the student to get out the self-statements list. Put out practice prompt- “Tell me all the different ways you could use a brick.” This time, let the student lead as much as possible, but prompt and help as much as needed. The student should make notes on the paper they wrote the reminders on. Go through each of the following processes.

Encourage and remind the student to start by saying, “What is it I have to do here? I have to write a list of good ideas. I will use the questions in RAN to help me write notes.” Help the student as much as they need to do this, but try to let them do as much as they can alone. If ideas can be improved, make suggestions. Encourage them to use other self-statements of their choice while they review their list.

_____ Say, “Remember that the first letter in RAN is R – Review key words and phrases.” Refer student to their self-statements for creativity or thinking free. Help each student focus on reviewing key words and to ask themselves what they know to start to think of good ideas. Prompt the student to write notes.


_____ Say, “The third letter in RAN is N – write, check, and add notes for more ideas. Prompt the student to check and add to notes. Tell the student that sometimes when you think of an idea, other ideas just start flowing out.

_____ Ask the student to prepare their note page for listing ideas by crossing out what and who answers.

_____ Ask the student to tell you a list of ideas to answer the prompt “Tell me all the different ways you could use a brick.” Write down ideas as they state them. Encourage the student to add to ideas.

_____ Have the student graph the number of ideas. Ask the student to determine if they have met their personal goal. Let them fill in the graph. Reinforce them for reaching their personal goal if they have, if not, ask them what they could have done to add more idea (e.g., thought of another “who”), praise them for generating good ideas and for working hard.

| Wrap-Up |

Repeat all steps of Lesson 4 again. Use Lesson prompt 4b for the second lesson. When you believe they have it, celebrate student learning!
## Lesson Overview

In this lesson, the student will use the independently use the RAN strategy for generating ideas. The focus of this lesson is to establish student independence.

## Student Objectives

The student will write their own notes and generate a list of ideas.

## Materials

Graphing chart, paper, pencils, prompt – “Tell me all the different ways you could use a cardboard box.”

## Set the Context for Student Learning

Tell the student that today they will generate a list of ideas. When they are finished, they will graph the number of ideas.

## Test the Strategy and Self-Regulation

Put out the prompt - “Tell me all the different ways you could use a cardboard box” and a blank piece of paper. Tell the student that this time; they will do everything on their own.

It is important that if the student is clearly struggling, that support is provided.

Once the student is finished with writing notes, ask them if they are ready to list their ideas. Give them time to cross out what and who answers (prompt them to do so if they forget). Write the students ideas as they list their ideas

- Ask student to count and graph their ideas. IF they did not reach their personal goal for ideas, prompt them to add more.
Wrap-Up

- Repeat this lesson or go back to lesson four if you think the student has not performed as well as they can (setting event, antecedent prior to class, etc.) and you feel they need more instruction based on their previous performance during instruction. Finish instruction on a positive note.

- If this is your last lesson, tell student that they are to remember what they learned with you when Mrs. Yukelson or another teacher asks them to generate a list of ideas for assignments. Get a commitment for this by completing the learning contract for the teachers.

- Tell the students that you will meet with them a couple of times to test what they have learned while working with you. Tell the student to remember to use RAN, ask questions, and write notes to help them remember generating ideas.
APPENDIX B
DESCRIBING OBJECTS WITH RAN!

R  **Review** key words or phrases in the prompt
   
   What is the topic?
   
   What do I know about it?

A  **Ask** myself questions (What-How, Who-How)
   
   What are the objects’ properties?
   
   How can the object be used?
   
   Who could use this object?
   
   How would they use it?

N  **Note** and list my ideas
   
   Write notes to help me remember.
   
   Check my notes, add more ideas.
RAN Graphing Chart

**Fill in a space for every idea**

<table>
<thead>
<tr>
<th>Ideas</th>
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**Date:**
My Self-Statements

To think of good ideas:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
LEARNING STRATEGIES CONTRACT

Student ___________________________ Date ______________________

Goal: ____________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

How to meet this goal: ______________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

Signatures: Student ____________________________________________________________

Mr. Taft __________________________________________________________

Mrs. XXXX __________________________________________________________
### Key Words

What is the topic
What do you know about the OBJECT?
Can food, made of metal, small, big, shiny Coke

### Ask W H questions

#### What How

What are the objects properties?
How can the object be used?

#### Who How

Who could use the object?
How would they use it?

<table>
<thead>
<tr>
<th>What How IDEAS</th>
<th>Who How IDEAS</th>
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<tbody>
<tr>
<td>1. Bird House</td>
<td>5. Pot</td>
</tr>
<tr>
<td>2. Dog house</td>
<td>6. Shovel</td>
</tr>
<tr>
<td>3. Piggy bank</td>
<td>7. Target</td>
</tr>
<tr>
<td>4. Alarm</td>
<td>8. Water cup</td>
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</tbody>
</table>

### Now

Write Notes and list your ideas?

Check my notes to help me remember.

What other “out of the box” ideas can I think of?

- Can food
- Shovel
- Bird house
- Target
- Piggy bank
- Phone

- Water cup
- Dog house
- Pot
- Alarm
- Drum

11 IDEAS
APPENDIX C
Assessment Prompts

A. Tell me all the different ways you could use a newspaper.
B. Tell me all the different ways you could use a screwdriver.
C. Tell me all the different ways you could use an automobile tire.
D. Tell me all the different ways you could use a shoe.
E. Tell me all the different ways you could use a chair.
F. Tell me all the different ways you could use a door key.
G. Tell me all the different ways you could use a clothing button.
H. Tell me all the different ways you could use a food plate.
I. Tell me all the different ways you could use a hair dryer.
J. Tell me all the different ways you can use a shovel.
K. Tell me all the different ways you can use a book.
L. Tell me all the different ways you can use a pillow.
M. Tell me all the different ways you can use a feather.
N. Tell me all the different ways you can use a toothbrush.

Lesson Prompts

Lesson 1: Tell me all the different ways you could use a string. Practice # 1
Lesson 1: Tell me all the different ways you could use a water hose. Practice # 2
Lesson 2: Tell me all the different ways you could use an aluminum can. Practice # 3
Lesson 3: Tell me all the different ways you can use a paperclip. Practice # 4
Lesson 4a: Tell me all the different ways you can use a brick. Practice # 5
Lesson 4b: Tell me all the different ways you can use a blanket. Practice # 6
Lesson 5: Tell me all the different ways you could use a card board box. Practice # 7
Note: prompts provided by or similar to the ones used by Wallach and Kogan (1966) and Torrance (1974).
APPENDIX D
Assessment Protocol

Lay out a blank lined sheet of paper and two sharpened pencils and the tape recorder.

Say to the student:

“I am going to ask you to tell me some ideas about a topic. I will use this tape recorder to tape what you say so that I can go back and listen to what you said later.”

Turn on the tape recorder, you can have the student say their name and date or you can do this. Rewind and listen to be sure the sound is correct.

Say:

“I am going to ask you to tell me all of the different ways that an object can be used. I will read you a prompt and then I want you to think of as many ideas as you can. There are no wrong ideas and you can take as much time as you need. You may use this paper to take notes to help you while you think of ideas. Listen carefully to what I read.”

Read the prompt out loud to the student 2 times.

Say:

“Take your time and think of as many ideas as you can. When you are ready, I will write down your ideas as you think of them.”

When the student is ready to tell you ideas, turn on the tape recorder.

*If the student asks if they have to use the paper to write notes, say, “You may use it if you believe it will help you think of ideas.”

Transcribe the student’s verbal responses so that the student can see the ideas generated. When the student has stopped ask,

“Do you have any more ideas?” (record any new ideas)

If the student states that they are finished. Say, “Thank you for working hard and telling me your ideas.”

Turn off tape recorder.
APPENDIX E
RAN

Social Validity

1. Has using the RAN strategy helped you generate ideas?

2. What have you learned since working with me/instructor?

3. How do you think the RAN strategy will help other children?

4. If you were the instructor, what would you change in the lessons? Why?

5. If you were the instructor, would you add anything to help children learn to generate ideas?

6. From these lessons, what things have most helped with generating ideas?
Rachael: Post-instruction 1 Notes Page

Rachael,

Beer
Bury Someone
Bury things
Knock someone out
Smash things
Garden: Plant things
Play with sand

√ Add what
Color
Size
Weight

√ Make Home in things
Pat things down
Hurt someone

√ What

How

For adults or kids
For kids - playing

Who
Teachers
Mom
Barb

Flaw

Dig worms for play
Decoration
Back in a hour
Alex 6/5/09

A √ report
scen a scen
open a door

A √ what

√ small

√ big

√ who

√ parent

√ kids

√ worms

√ how

√ fix

√ toy
to build
R
- under lock a door
- use it for an experiment
- paint
- play games with a door key

A
- light, smooth, skinny, pointy
- unlock a door
- use it for an experiment
- pain it
- play game with

Parent: may use it to
- unlock your door

Science may use it for an experiment

Painter: may paint it

Kids may play games with it.

N
APPENDIX G
Informed Consent Form for Social Science Research
Project Title: IRB # 24762 Writing Instruction

Dear Parent or Guardian,

My name is Linda Mason. I and other researchers at Penn State University (Dr. Rick Kubina) and George Mason University (Dr. Margo Mastropieri) are conducting research on persuasive writing. Presently, I am seeking research volunteers to participate in a school based research study on strategy instruction (Writing Instruction for Students). I am seeking parental consent to enroll your child, along with other students in his class, in a research project. The project is aligned with the regular classroom curriculum, involves learning experiences provided by your child’s classroom teacher and a graduate research assistant, and would last approximately ten weeks (ten to twelve 30-minute sessions plus fifteen to eighteen 10-minute sessions). If you are interested in allowing your child to participate, please continue reading, and then note your agreement to participate by signing and dating at the bottom of the page. If you are not interested, please do nothing. Do not complete this form. If you choose to do nothing, please be assured that your child will not be enrolled in the research. Rather, he or she will be offered a similar learning opportunity that would not involve research.

The purpose of the research is to determine the effectiveness of a strategy intervention on student performance in writing a persuasive essay. Your child will participate with their classmates in this project. The researchers will train your child’s teacher and the graduate research assistant in writing strategy instruction and the assessments to be used to measure performance. Your child’s teacher or the graduate assistant will assess your child prior to instruction and teach the strategies to your child after the consent form has been signed. After instruction your child’s teacher or the graduate assistant will assess your child. Drs. Mason, Kubina, and Mastropieri will collect student performance data that will be stored in a secure area in their office. In addition to performance data the researchers, with your permission, will collect information from your child’s school file. This information will also be stored in a secure area in either Drs. Mason, Kubina, or Mastropieri’s office.

Instruction will be video taped so that the researchers can better understand how you child and others learn from the instruction. This data will also be stored in a secure area in Drs. Mason, Kubina, or Mastropieri’s office. The videotapes will be destroyed within 5 years of the project.

After the intervention in the study, your child might have a better understanding of writing a persuasive essay. Your child might learn how using strategies affects his or her writing. It will take about 30 minutes for approximately 12 days over 4 weeks plus 10 minutes for approximately 18 days over 6 weeks for your child to learn the writing strategies and complete the assessments. Your child’s teacher has agreed to allow this research to be conducted in their reading class. The risks to your child would not be beyond normal daily living or classroom learning.

Your child’s participation in this research will remain confidential. Only the principal investigators (Dr. Linda Mason, Dr. Rick Kubina, and Dr. Margo Mastropieri) and your child’s classroom teacher will know how your child responded on the writing assessments. The data from the assessments, school files, and videotapes will be stored and secured in Drs. Mason, Kubina, or Mastropieri’s office on a locked, password-protected file. All data will be destroyed by September 1, 2012. In the event of a publication or presentation resulting from the research, no personally identifiable information about your child will be...
shared. The following may review and copy records related to this research: The Office of Human Research Protections in the U.S. Department of Health and Human Services, Penn State University’s Social Science Institutional Review Board, and Penn State’s University’s Office for Research Protections.

This research is funded by the United States Department of Education, Institute of Educational Sciences. Your decision to permit your child to participate in this research is voluntary. Your child can stop participating at any time. Your child does not have to answer any questions he or she does not want to answer. Refusal to take part in or withdrawing from this study will involve no penalty or loss of benefits your child would receive otherwise.

Please contact the Office for Research Protections (ORP) at (814) 865-1775 with questions, complaints or concerns about your rights as a research participant, if you feel this study has harmed you, or if you would like to offer input. The ORP cannot answer questions about research procedures. All questions about research procedures can only be answered by the principal investigator. If you have questions about the research, please call Dr. Linda Mason at telephone number: 814-863-7500.

If you agree to the information described above and will allow your child to participate in the research, please print your child’s first and last name below and sign both copies of the parental consent forms provided in this mailing. Then, please return one signed copy to your child’s teacher **within 10 days of receiving the information about the research**.

---

Print First and Last Name of Your Child

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<th>Parent or Guardian Signature</th>
<th>Date</th>
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May the researchers collect data from your child’s school file for research purposes?

I **give** permission for data to be collected from my child’s school file.

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<th>Date</th>
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I **do not give** permission for data to be collected from my child’s school file.

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<th>Parent/Guardian Signature</th>
<th>Date</th>
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May the researchers use video recording devices for research purposes?

I **give** permission for my child to be video taped. 

______________________________

Parent/Guardian Signature

Date

I **do not** give permission for my child to be video taped.

______________________________

Parent/Guardian Signature

Date

May the researcher use your child’s photograph or voice records in the future?

I **do not give** permission for my child’s recording to be archived for future research project. The videos will be destroyed by September 1, 2012.

______________________________

Parent/Guardian’s Signature

Date

I **do not give** permission for my child’s recording to be archived for educational and training purposes. The videos will be destroyed by September 1, 2012.

______________________________

Parent/Guardian’s Signature

Date

I **give** permission for my child’s recording to be archived for future research project.

______________________________

Parent/Guardian’s Signature

Date

I **give** permission for my child’s recording to be archived for educational and training purposes.

______________________________

Parent/Guardian’s Signature

Date

Person Obtaining Consent: Principal Investigator

______________________________

Date

**Linda H. Mason**

210 CEDAR Building

Penn State University, University Park, PA 16802

EMAIL: lhm12@psu.edu

TELEPHONE: 814-863-7500
Vita
Raol J. Taft

Education
2006-present  Ph. D. Candidate in Special Education, The Pennsylvania State University
2003        MA in Special Education, University of Illinois, Champaign-Urbana, Ill.
1991        BA in Biology, Metropolitan State College, Denver

Publications
Mason, L. H., Kubina, R., & Taft, R. J. (in press). Improving quick writing skills of middle school students with disabilities: Results of two studies. Manuscript accepted for publication in Journal of Special Education.

Taft, R. J. & Mason, L. H. (in press). Examining effects of writing interventions: Spotlighting results for students with primary disabilities other than learning disabilities. Manuscript accepted for publication in Remedial and Special Education.

Professional Experience