Memory Enhancement in Adult Learners
by ARTHUR LEE ALT

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Education
Montana State University

Abstract:
Although investigations into human memory have been occurring for over one hundred years, the basic factors of memory are still not understood. Factors such as attention, acquisition and encoding of material, rehearsal, experience, and retrieval are important determinants of memory ability, but their individual importance changes with circumstances. Researchers have investigated each factor in memory in a variety of experiments, but little work has been performed on the possibilities of training adult learners to enhance their memory skills. Without memory, there can be no learning, but many students have never learned nor have been taught any methods for increasing their memory abilities. Therefore, the purpose of this study was to test the effectiveness of specific memory technique training on adult learners and to evaluate the possible successes of such training.

The design for this study was a case study which involved the collection of both qualitative and quantitative data. The primary methods for data collection involved an initial student memory evaluation by use of the SKILLS instrument, pre-tests and post-tests given before and after the memory training sessions, application of the Kolb Learning-Styles Inventory instrument for investigation of relationships between learning style and memory abilities, and a series of interviews and observations of the participants both during and after the training.

The results of this study indicated a number of areas that memory enhancement could be applied to adult learners. Test scores indicated significant improvements in ability to retain and recall all elements of the training. Interviews indicated the overall impression of memory training was that it was a definite success, although several of the techniques demonstrated were considered too difficult for regular use by the majority of students. The consensus of opinions was that more time was needed for the training program. Students found numerous advantages to the lessons, the most common being more free time and better grades. Disadvantages mentioned included the need for slower reading and the availability of too many techniques presented in the four week period.

The study indicates students with no prior exposure can benefit from memory enhancement training. Learning style does not adversely affect the way students learn memory techniques. The key elements in training memory in adult learners includes attention, motivation, structuring of materials, rehearsal, imagination, and the incorporating of fun elements into the interactive learning events. Memory skills can be taught and enhanced in adult learners at all levels of memory development.

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APPROVAL

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

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CHAPTER 1

INTRODUCTION

Background

Memory problems have now been investigated for at least 100 years beginning with Ebbinghaus's published work in 1885 on remembering words and nonsense syllables. Prior to his work, Ewald Hering in 1870 (James, 1890) characterized memory as a general feature of organized matter, maintaining that since memory manages to survive sleep and other periods of unconsciousness, it cannot be associated simply with conscious thought. He felt it had to be considered an inherent capacity of the brain, following rules of regular material processes. More importantly, Hering considered memory to have a capacity that should be stimulated using memory enhancement techniques.

In reality, the use of memory techniques for handling accurate recall of vast amounts of materials go back as far as the ancient Greeks. Described by Cicero in 55 BC, the Method of Loci allows the learner to put information together via linking pictures of previously designated locations with newly formulated images of the material to be remembered. By making use of such a pre-arranged visual map linked to the objects to be recalled, an interaction -- but not necessarily lively -- situation is devised. This

mental construct was based solely on the learner's own knowledge base and experiences. This allows linking of new information with material already channeled into the brain. However, it has been found by psychological experimentation to be useless for most practical purposes in average persons (Ericsson, 1985) except for special individuals such as S.V. Shereshevskii who apparently used it extensively as a professional mnemonist (Luria, 1969).

Such techniques as the Method of Loci are typical of mnemonics, which are simply (but are not necessarily simple) cognitive techniques designed to assist the learner assimilate, form mental connections, and ultimately recall specific pieces of information without undue stress. Essentially, by assisting in organizing material, such memory techniques allow for greater comprehension, concentration, and remembrance of information and details. In many instances, those details may have virtually no real meaning (i.e., are abstract in conception) for the individual. As artificial memory producers, such techniques contrive meaning into topics that prior to the learning experience have no significant relevance for the learner.

Mnemonics

There are numerous such well-known mnemonics, including the days in each month of the year; the lines and bars on a music score (EGBDF -- every good boy does fine -- and FACE); the stellar classification system based on temperature, color, and size (OBAFGKMRNS -- oh, be a fine girl, kiss me right now, smack!). Without mnemonics,

such material would be much more difficult to assimilate. That in turn necessitates much greater concentration and requires a vastly higher time expenditure, both of which are common problems for learners of all ages. The Law of Effect (Thorndike, 1898) is most applicable here and holds equally well for learning and memory. This law maintains that actions that lead to or cause immediate pleasure are learned, remembered, and quite often become habitual -- conversely, action leading to pain or discomfort are not remembered or are even suppressed!

In many memory systems, the guiding principle is to reduce the memorization process into a series of more meaningful elements, based on much smaller bytes of information in place of focusing on the entire picture. For example, Americans appear in general to be terrible at comprehending elements in paintings (M. Freel, Professor of Fine Arts, personal communication). Basically, they have learned to look at the entire work for analysis and not to reduce it down into more manageable, understandable units. This essentially says, "Get the general overview, ignore the finer details." Perhaps this also explains American students dislike for learning foreign languages (Lorraine, 1975) since a grasp of the nuances and the fine elements are required to become fluent in the language rather than simply rehearsing the larger aspects of a language.

Unfortunately, mnemonics seem to be of limited use primarily because many materials are not easily translatable into pictures. The average adult learner often makes use of repetition for learning materials. Study techniques are taught using that expedientalong with such physical activities as underlining, outlining, highlighting, and

several others that perforce the student to engage more than just visual senses in the learning process. Numerous experiments have been designed and implemented involving the effects of repeated readings/listening/sayings. Most showed an associated negative accelerating learning curve as the accumulated effect of repeated repetitions on retention of information (Baddeley, 1976). Those experiments clearly showed that such repetitions did not guarantee at all that retrieval would be either clear, accurate, or effortless. Instead, what most often seems to occur is that the learner's success at recall is much more dependent on how well the learner places the new material in the existing framework of past experiences and knowledge. This process is referred to in several areas of science as embedding (Seamon, 1980).

Memory Elements

To integrate material into memory, one of the basic requirements is the ability to concentrate. Gestalt psychology has tied this element of mental ability to recall via four principles that are fundamental to retrieval of information :

1. Every object perceived to be involved in a memory pattern stands out or is perceived against a simpler background (figure and ground principle);
2. All materials attempted to be committed to memory lend themselves to organization into distinct perceptual structures already known by the learner (segregation principle);
3. All materials only partially learned will, when recalled, be perceived as wholes (closure principle);
4. All materials which are strongly derived or emphasized, or formed in a more complete, detailed fashion will eclipse or override any less strong or less developed memory traces (good Gestalt principle). (Pickford, 1972, p. 280)

These principles imply that a fundamental element of learning is attention, or the ability to concentrate. Although studied diligently in the early 1900s (Titchener, 1900), attention disappeared as a suitable topic for study until it was revived as an important issue in 1958 (Broadbent, 1958). Since that time, over twelve theories of attention have been proposed. Several investigators have shown that more learning occurs when there is more total effort put on attention and that very dramatic increases in learning ability can be developed with practice (Fry, 1995).

Another primary element of memory is experience. John Dewey, one of America's best known educators, believed firmly that the education of people involved experiences and that such experiences formed the basis from which all original thoughts and material interpretations would come. In his perspective, all such experiences, particularly personally shared experiences, would act in a manner that provides infinitely more education than any learning occurring from simply reading a book. Intelligence, which is a prerequisite for memory ability, can be attributed to experience. However, the problem with intelligence is how the term is defined, measured, and quantified. Intelligence is defined in a variety of ways (Zechmeister, 1982) such as (a) the ability to carry on abstract thinking, (b) the ability to adapt oneself adequately to relatively new situations, or (c) the capacity to learn or to profit by experience. All of these have included within their structure the element of experience as a necessary part of memory/learning work.

An additional element of memory is forgetting. Such an event can take place under three possible causes (Baddeley, 1976). First, information may simply have been lost from whatever the brain used as a storage system. This could be due to decay of the mental construct (as happens in short-term memory), displacement of material by new information or memory patterns, or by modification by new information. Second, there may be lack of recall due to stored information being well-hidden. There is daily evidence of this, particularly when the right elements are not forthcoming as needed but show up in pieces later. Third, there may be an encoding deficiency where not enough information has been used to permit differentiation from what is already been placed in the brain.

Likewise, the element of aging presents another distinctive memory problem involving memory decline and decrease in the recall rate (Charness, 1985). Part of the supposed decline can be offset by knowledge garnished through later-in-life experiences. The slowing of the recall rate can be accounted for by the signaling processes within the brain and the sense organs becoming weaker with age. This can be overcome by people taking a greater amount of time during the learning period (Birren, 1977). For example, using six or seven digit numbers, recall by older people is found to be equal to that of younger people if increased practice recall via repetition is performed. This is also illustrated by the fact that materials well-learned or highly familiar events and skills such as bicycle riding are retained extremely well even into old age.

Memory Investigations

As with many aspects of scientific investigation or computer-problem solving, a logical beginning would be to set up an algorithm. This seemingly innocent term refers to a predetermined procedure or strictly ordered sequence of clearly delineated instructions for carrying out in a finite number of steps the desired operation. This would contrast sharply with the mental state known as anoesis, literally the absence of thought. In this situation, consciousness is present, individuals still have sensations, but no thought is taking place. Experiments using positron emission tomography (PET scans) have revealed that in the brain the primary visual cortex is activated when subjects close their eyes and visualize objects (Kosslyn, 1995); when resting or not imaging, no activity is found. Moreover and most importantly, such mental processing involves depictive representations which are not solely language-like descriptions. Work has already been done on using oral traditions to shed light on how memory works by essentially asking how oral representations are used that for some reason are more memorable than others. This is Sperber's Law of Epidemiology of Representations, which holds that in an oral tradition, all cultural representations are easily remembered ones; hard to remember representations are forgotten or transformed into more easily remembered ones before reaching a cultural level of distribution (Sperber, 1985, p. 86).

Apparently, as Sperber points out, people are better at remembering a story than textual material. For example, everyone finds themselves accidentally recalling an

advertising jingle, including all the basic elements of words, rhythmic characteristics, colors, movements, and all sorts of basic substrates. Making things cute, or picturesque, seems to work to facilitate either recall or locking information into the unconscious mind. In this respect, it is highly likely that the total detail of the representation formulation is just as important as the content material to be memorized. This would fall quite appropriately into the subject matter of metacognition which deals with an individual's knowledge and ability to direct one's own thinking and learning processes. This includes (a) planning with critical analysis of the best or the most efficient method to use in dealing with a specific learning project; (b) monitoring or assessing how the learning is proceeding throughout the course of the project; and (c) adjusting the level or technique to improve one's actions in the learning situation, using some form of evaluative feedback to alter the strategy for the better. These three relate equally to the memory skill developed since they are all sustained by interaction with how the memory patterns are organized and what techniques are being used to develop and reinforce the mental images in the first place.

Memory Processes

Although the biological basis for memory is poorly understood, it is clear that two processes which are somehow connected, are involved. The first process must be acquisition or the learning of new material. This new material can be either a skill or information. The second process is called retrieval which is the later recall of that datum.

The connector needs to be some change in the brain properties itself, either locally or spread over a larger area to act as a storage center for the acquired datum. That stored piece of information is now known as an engram, or memory trace, a convenient term for a faculty which is totally unknown.

Much research has been done on memory and particularly on biological bases (Carlson, 1991; Kosslyn, 1992; Kosslyn, 1995). However, very little research has been conducted on techniques of improving memory abilities, particularly in those learners who have low skill levels in recall and poor metacognition levels in the first place (Fry, 1995). What techniques are applicable to invigorate low skill levels? Do some techniques have greater potential for one type of material compared to another -- for example, does one technique work better for memorizing foreign language words and not for retaining a listing of activities for a day or for internalizing the relevant points from a textbook on chemistry? Are the techniques difficult to teach, or are they simple enough that they could be started at a much lower level than adulthood? Does one's range of life experiences affect the ability to learn such techniques? Can such memory skills be taught with a modicum of esoteric terminology without a necessary scientific understanding of how the brain system works or how memory patterns become encoded, switched, or retrieved? Can such memory techniques be applied to rigorous, detailed material or are they useable only on listings or generalities? Are those learners with poor memory abilities also handicapped with poor motivational skills and thus basically unaware of and lacking any control over factors motivating and directing their own learning? On a

generational note, do students who are older and from an earlier educational system show more memory abilities than do younger students? Are there indications that memory skills are currently being taught in the pre-collegiate educational systems? Does poor memory skills have a significant effect on the daily lives of people in their own society? Are memory skills more prevalent in one sex than in the other, or in one age grouping compared to others? Thus, numerous unanswered questions exist concerning the relationship of memory skills with other life factors involved with adult learners.

Problem

Without memory, there can be no learning. Yet, many students have never learned nor have been taught any methods for increasing their memory abilities. Many students learn by repetition or repeated readings with the formation of random recall patterns in their brains.

It has been known for years, particularly among college students, that the one effective mechanism for learning and recalling important (i.e., testable) material is by understanding it. The problem, however, quite often revolves around the necessity of formulating memory traces on information that is not particularly understandable nor is necessarily visualizable. The problem for students, and in particular for those not comfortable with memory skills, is to be able to develop their own techniques or to use modifications of ones learned by prior experiences to fit the current circumstances. Unfortunately, those who are being required to memorize and internalize whole bodies of

unfamiliar and perhaps highly detailed material and who are most in need of the abilities requisite to developing such memory skill techniques are those less likely to either have the techniques already on hand or to be able to modify them intelligently to fit the circumstances based on the advantages or perceived disadvantages of each technique.

In experimental studies, research has concentrated on questions dealing with what and how much is learnable, with how quickly materials can be integrated into the stored body of knowledge, and with the time intervals over which different elements can be retained (Zechmeister & Nyberg, 1982). Outside the realm of memory techniques, there have been extensive studies performed dealing with brain systems on the biochemical, physiological, and cellular levels (Seamon, 1980). However, the application of specific memory techniques such as the Method of Loci have been virtually ignored. It is in these techniques that students, and particularly those of low memory skills, may find a means and tools to re-implement their own metacognition and memory abilities.

Purpose

The purpose of this study was to test the effectiveness of specific memory technique training with students possessing various levels of memory skills and to evaluate the possible successes of such training. This involved identifying student memory skills levels at the beginning of the instruction and the memory techniques they have assimilated through prior education and currently use. Students were identified and grouped according to their use of memory learning strategies. Then, by using pre- and

post-testing evaluations, the ability of students to gain from such a course on memory improvement was investigated, including the application of a variety of memory techniques and stimulants to problems of concentration, comprehension, short-term and long-term memory, and structured recall.

Significance of the Study

For adult education, there are many reasons such a study should be undertaken. Among those reasons are:

(a) Poor memory skills lead to a great deal of wasted energy, resources, and time for people who are forced to habitually repeat and relearn materials over and over;

(b) Poor memory skills lead to loss of self-esteem and a further reduction in the interest of learning, forcing such people further behind in learning skills and knowledge necessary for the future;

(c) Investigation of memory techniques that are teachable would provide a tremendous accessible tool for dealing with learning problems based on either poor motivation, metamotivation, or memory skills;

(d) There is a need to develop in the educational system a basic set of techniques that *all students* can acquire to enhance their learning ability;

(e) The development of a series of memory techniques would allow students at any level to become expert in an area at a much quicker pace with subsequent benefits in

learning and reasoning ability, in time saving, and in the interest to expand learning into additional fields of study;

(f) The techniques would assist learners into a program of life-long learning with the reduction of stress commonly associated with learning new materials, stress due to the lack of adequate memory techniques;

(g) It may help reduce the belief commonly held in America that learning is a strain (Holt, 1964) which involves hard work and suffering (the basic old Protestant work ethic) and could replace it with an understanding that learning can be enjoyable and contribute to a more positive outlook;

(h) It should show how to enhance the joy of learning by making what was once difficult to make in mind become easier and more retrievable; and

(i) Most importantly, such studies should show how to stimulate the brain like a gigantic muscle -- the use it or lose it syndrome -- and that the process can be more efficient and durable and can last throughout one's life without deterioration unless changed by desire or deliberate misuse such as drugs.

Researcher Background

This study was developed as a result of the experiences of the researcher in teaching various sciences to predominantly non-science oriented students with a well-established fear or dislike of any form of scientific endeavor. In the practice of teaching over twenty years at the college level, it has become apparent that one of the major blocks

students are forced to quite often overcome is a lack of any memory skills. It would seem justified to believe that students coming through the American education system should have learned how to learn effectively, how to memorize materials and internally organized them into relevant, easily retrieval forms. This, however, has not been observed by this researcher.

In place of ease of memorization, comprehension of materials, and learning of concepts, the researcher has noted a general lack of ability, particularly in encoding the material into long-term memory and in the use of any sort of critical thinking process involving the use of such stored material. This inability to even think about what they are doing, either as metacognition or metamemory, has made the college experience for many students a much more challenging set of events. The challenge is one dictated by the limited amount of time available for reading, re-reading, and re-reading, in the hopes material will stay in place in memory long enough to pass required examinations.

Whatever the problem, whether it be lack of confidence in oneself, lack of study skills, or the total lack of any training on memorization skills and use of memory aides, this researcher has found over the years that even a minor amount of training in developing memory abilities pays tremendous dividends for the individuals involved, in particular in terms of self-confidence, reduction of time necessary for studying, and a more positive outlook on general study skills. Such training, while not entirely eradicating the problems that go along with poor study habits or lack of higher thinking skills, would go a long way in reducing student frustration with the college learning

experience, changing the learning experience to one of enjoyment, comprehension, understanding, and reducing the fear level that students will, before they are given instructions, approached new material.

Research Questions

The ability to influence the memory, retention, and recall of information is assumed by all teachers at every grade level of instruction. However, very little formal instruction is provided to maximize a student's memory abilities, the long-term retention of material, or the comprehension level of the materials being studied. Therefore, the primary questions of this study are:

(1) What memory techniques are learned most effectively by students who enter a program of training already possessing diverse memory skills?

(2) Can memory skills be taught directly such as skills like typing?

(3) What effect does practice have on the development of such memory skills?

(4) What memory techniques are learned most effectively by students who have low memory skills initially?

(5) What role does motivation play in developing memory abilities, particularly in students who enter the training program with low memory skills?

(6) How do users with different cognitive styles react to memory training?

(7) Do learning styles correlate with ability or inability to learn skills through a memory training program?

Definition of Terms

General

Acquisition: The means by which a learner encodes, or puts information, into memory storage. The term refers to all the subsystems responsible for acquiring information and placing them into short-term memory for further processing (Houston, 1991).

Chunking: A memory process in which a number of related items are stored and retrieved as a unit in order to facilitate memory. The subsystem involved allows for storage of massive amounts of material in memory in an organized fashion (Miller, 1956).

Cocktail Party Effect: A documented effect in which information that is being attended to will be remembered, whereas information that is not being attended to will be forgotten or not learned. The phenomenon is described by the way people switch their attention among different simultaneous conversations at large parties. The effect itself necessitates at least two modes of action for the attention system (Buzon, 1989).

Cognitive Science: The field that explores the mechanisms through which people acquire, process, and use knowledge. It's importance lies at being at the basis for the educational practice. The interplay between Cognitive Science and other fields of

scientific research have led to major discoveries on the operational processes involved with the diverse systems of memory in the human brain (Bourne, 1979).

Elaboration: This process refers to the establishing of linkages between new information and previously stored information in long-term memory. Through the process, more neural pathways are created with previous existing memory traces, allowing for clearer and easier retrieval of information (Walker & Jones, 1983).

Encoding: Any mental operations performed on information arriving in the sensory system that form memory traces of that input. The material is acted on by the Encoding process while in the short-term memory system. Numerous factors then determine if the established traces will be re-localized into the long-term memory system (Thomson & Tulving, 1970).

External Memory Aids: The deliberate use of lists, timers, calendars, and similar devices to remind an individual to do something at a particular time. Such assistance does little for the development of memory skills (Lorayne, 1975).

Interference Theory of Forgetting: A theory of how people forget based on interference or displacement of the to-be-remembered items by other material that has been previously or subsequently learned. The theory is in direct opposition to that of gradual decay, where memories are lost or modified over time as the memory traces wear out due to age or non-usage (Eysenek, 1977).

Internal Memory Aids: Mnemonic devices or memory aids that rely on plans or strategies to make retrieval easier and more likely. Such devices are either installed prior to a memorization event in the brain, or they are used as convenient association points to hook to the information while it is being converted into a memory trace (Houston, 1991).

Learning: This is the process whereby knowledge is created through the transformation of experience (Kolb, 1984). Intimately related to memory, the processes of Learning are diverse in nature, but all revolve around the establishment of a basic core of knowledge placed in the brain for future usage.

Learning Environment: The environment of learning that plays a premier role in transforming knowledge and experiences into viable memory traces. These include affective, perceptual, symbolic, and behavioral complexes. Numerous factors within the environment play large roles in the establishment and retention of memory traces (Baddeley, 1976).

Learning Strategy: The set of tactics or methods an individual uses in dealing with any particular learning task. Strategies will vary from task to task. The type of Learning Strategy used can range from the simplest identification ones to those of higher order thinking, including critical thinking, synthesis of concepts, problem-solving, and scientific evaluation (Conti & Fellenz, 1991).

Learning Style: This deals with how an individual handles new information, events, or circumstances in the present environment. It also refers to the particular mode of learning that an individual prefers (i.e. visual, auditory, kinesthetic) when new material is being presented (Kolb, 1985).

Long-Term Memory: The memory system, of unlimited scope, that retains information over long retention intervals. Among the unanswered questions is how material gains access to the storage system, and why do some memories vanish after a brief time interval but others are seemingly permanent (Waugh & Norman, 1965).

Memory: A system of the brain that allows for the acquisition, encoding, temporary storage, and long-term storage of information. Although often attributed to higher developed organisms only, many of the subsystems of memory are found in the invertebrates. Occurring in several alternate forms, the processes acting within the subsystems are a major area for study in the cognitive sciences (Anderson, 1983).

Metacognition: The term refers to the ability to know about and direct one's own thinking and learning processes. Metacognitive skills include the ability to predict the results of one's own problem solving actions, to check the results of one's own cognitive processing, to monitor progress towards a problem solution, and to test one's actions and solutions (Brown & DeLoache, 1978).

Metamemory: An individual's knowledge about how his/her own memory system works, including components of organization, external aid usage, and memory application. In detail, it involves the structuring of information so that the material will be best stored, retained, and retrieved, using either external aids such as writing down lists, or internal aid application, such as the use of mnemonics or mental images (Anderson, 1983).

Mnemonics: Memory aids or techniques that are utilized to improve memory. They range from the simplest tying-a-string-around-a-finger to highly complex image formation systems that allow for inputting in a recoverable fashion the most abstract of concepts (Houston, 1991).

Recency effect: The concept that the more recent the memory, the better it is (Cohen, 1981). Part of the effect suggests that the time lag between repetitions or rehearsals of material is not important. In general, the effect depends greatly on the attention level expressed during the learning period (Glanzer, 1972).

Retention: The storage of information into the memory code from experience until it is needed again. This means that Retention problems are significant in being problems of storage of adequately coded information. Key elements include attention focused on the material at the time of memorization, the formation of memory traces, and the elaboration occurring during the encoding process (Houston, 1991).

Retrieval: The act of recalling or remembering information that has been previously stored in memory. The system is responsible for locating, analyzing, synthesizing, and elaborating material in response to requests supplied to long-term memory. Retrieval only works well when the information is clearly marked or has been adequately associated with other materials present in the brain (Baddeley, 1986).

Schema: This is what allows automatic processing to occur in long-term memory (Neisser, 1976). It is the coherent framework that has been derived and interpreted from past experiences. Evidence suggests Schema change with time and experience and organizational structures imposed from outside the brain.

Short-Term Memory: The limited capacity memory system that stores memories lasting up to approximately one minute. Also often called working memory, the system is strongly tied to the attention, acquisition, and encoding systems (Waugh & Norman, 1965).

State-Dependent Memory: The ability to recall certain events or information is facilitated when individuals are in a mood or state of recall that is similar to the one they were in during the time of original acquisition. Apparently the easiest memories to retrieve are found when the individual is in the same state as when the memory experience occurred originally (Houston, 1991).

von Restorff Effect: The perceived effect where one item differing greatly from the others in a list is remembered better (Cooper & Pantle, 1967). Any item with a clearly distinguishing characteristic will be remembered at the expense of more similar items. The counterpoint to the effect is that memories tend to be short and easily lost if there is not numerous associations made in the brain with already well-remembered materials.

Training Program Terms

Creative Mind Maps: Mental maps that have a centralized focal point representing the major topic from which pathways stream out dealing with the additional concepts or ideas relevant to the subject. The pathways are intermingled with key words, concepts, or images. In advanced mathematics such diagrams are called Tree Diagrams.

Copy-cat Words: Words that are used to make mental images that look like the word or idea to be remembered. For example, for bork one might use cork, book, or bore to formulate a picture.

Homeroom Map System: Originally known by the Romans as the Method of Loci, the technique uses a well-known room in the learner's own home as a focus for locating pictures of information to be retained. By associating information with objects already located in the room, the information becomes much more organized and systematically retrievable.

Letter Alphabet: Memory technique associating each letter of the alphabet with a picture and a numerical value forming a second picture. For example, "T=turtle = 20 = Nose (by the Number Alphabet System). So turtle is incorporated into a picture hanging onto a nose. Useful for memorizing mathematical formulae, chemical reaction mechanisms, most interrelated number-letter quantities.

Make-believe Pictures: Process of making pictures that are familiar to replace words or ideas that are too abstract, nonsensical, or impossible to easily make mental images of. Works extremely well for foreign languages and specialized terminologies. For example, in place of schwarzkopf, one might use quarts coughing tied to the picture of the real meaning of the German word.

Memory Chart: Technique using a box chart with the Letter Alphabet on one axis and the Number Alphabet on the other. Data are located in the appropriate squares for retrieval in relation to each other. Useful for maps, tables, graphs, and any material in quantity that can be placed in a chart format.

Number Alphabet: A vastly useful system that uses pre-assigned letters and associated words for numbers. This allows information to be memorized in order, and allows for the handling of numbers in the forms of dates, addresses, telephone numbers, or any numerical data. For example, "2" is associated with the letter "N" and the word

"Noah", while "22" would be associated with the letters "NN" and the word "Nun". Any number can be immediately converted into visual mental images of corresponding words.

Picturization: A fundamental process of visualization in which the learner transforms every element desired to be remembered into an active visual mental image. Elaboration processes include color enhancement, forming ridiculous and exaggerated images, adding elements of motion and 3-dimensionality.

Recall Pattern: Technique for placing materials to be retained in a logical format that allows retrieval from front-to-back, back-to-front, or working from the middle in either direction. Typical patterns include circular, trellis, diagonal, and random.

Rhyming Order System: This memory technique uses rhyming words corresponding to numbers to order memorized material. For example, learners often uses sun as the rhyme for one, so the first information to be remembered is associated with an active picture of the sun.

Shapely Figure System: Memory system that uses the shape of a number to make a picture which can then be attached to material to be retained in numerical order. For example, the number two often uses a duck or swan in the picture to locate a bit of information in the second position.

Storyline Process: This process is the linking of mental images together to turn information to be remembered into a story or movie, incorporating all the pictures into an action sequence. The idea of a Storyline allows associations to be formed in the brain that allow for more rapid and easier recall.

Limitations

All participants for this study were chosen from the local student population enrolled in either the University of Great Falls or Montana State University- College of Technology. It is possible that students in other regions may react differently to memory instruction.

Delimitations

Although the participants chosen for this study were all students, many were also involved in different professions. These professions included college professors, college administrators, medical specialists, Air Force officers, nurses, and blue-collar workers. Several participants were students having never worked outside the school environment, while others were currently full-time students having worked in some profession prior to returning to school.

Assumptions

It is believed that the individuals selected for this study represented a fairly broad spectrum of students involved with the use of memory skills, both in terms of their original ability and their prior knowledge of memory techniques. Moreover, because of the wide range and diversity of learning styles that were represented by the participants, it is believed that a typical range of approaches to memory use, with associated problems and beliefs involving poor memorization abilities, was present in the study participants.

CHAPTER 2

LITERATURE REVIEW

Learning

What learning entails is a large question for researchers in education. Quite often it is continual, effortless, inconspicuous, complete, commonplace, ordinary - it occurs so often that we rarely think about it while going through daily life. If anything, learning is not difficult (Holt, 1964, p. 38), since it often doesn't even require deliberate motivation, so that often we learn without knowing that we are learning. Formalized education and schooling has indeed made this idea seem somehow strange, in that many educators consider learning to be sporadic, difficult, necessitating major effort, requiring special motivation, incentives, and rewards (Holt, 1964, p. 39). What distinguishes these two views? Learning is easy when it is part of the normal flow of events in which a person is involved, when sense is made of what is being done and when the individual's brain is operating on its own affairs. Learning becomes difficult when it is deliberate, done against the flow of events, and made the specific focus of attention, when it is oriented to some future goal rather than to present interest: in other words when it is forced. Learning that is driven by determination and effort is paradoxically likely to be the least efficient learning of all (Holt, 1964, p. 40).

Materials must be learned in different ways. Fox example, recall of non-word material is done differently than for word-like materials (Gathercole, 1995). Ausubel points out that different tasks have different requirements (Ausubel, Novak, & Hanesian, 1978):

> Potentially meaningful learning tasks are, by definition, relateable and anchorable to relevant established ideas in cognitive structure ... Rotely learned materials, on the other hand, are discrete and relatively isolated entities that are relatable to cognitive structure only in an arbitrary, verbatim fashion ... They are learned and retained in conformity with the laws of association. (p. 144)

In Ausubel's theory of assimilation, meaningful learning only occurs if the material is presented in such a way that it makes itself potentially meaningful, and only if the learner has a necessary anchoring set of ideas and knowledge that allows linkages to be established with the new material.

Memory and learning are intimately related. Based on extensive clinical neurological investigations, Nielsen (in Squire, 1987) found two forms of memory involved in learning. The one form involves memories of life experiences centering around the person himself and basically are focused around the element of time. The other type includes memories of intellectually acquired knowledge that has not experienced. It has been learned by study and therefore is not personalized unless done by the learner.

On the basis of the interaction of learning and memory, learning can be defined (Kolb, 1984) as the process whereby knowledge is created through the transformation of

experience. This emphasizes several aspects that are critical to the investigation of memory. First, there is an emphasis on the process of adaptation and learning, as opposed to content or outcomes. This is relevant because memory can be shown to be a successful process or structure building new materials on previous learned ones, allowing for the organism to adapt to changing conditions or requirements in the environment. Second, knowledge is a transformation process, continuously created and recreated, not just a collection of material to be acquired or transmitted. For memory, the essence of this is that memories change, are augmented or depleted, depending on the circumstances of the environment and individual needs. Third, learning transforms experience in both objective and subjective forms, and it is these experiential changes that become fixed in the brain as memory traces. Lastly, to understand learning, and therefore memory, it is essential to understand the nature of knowledge, and vice versa.

A major approach to this study and understanding of memory is that of cognitive science, dealing with, among other things germane to memory studies, information processing, knowledge types and knowledge representation. According to information-processing theory, the central concept of cognitive science, humans are symbol or information processors; input enters the system in the form of symbols or symbolic representations, activates particular cognitive processes, and results in physical or mental actions. Those actions occur as individual components of knowledge are processed. From cognitive research, there are three types of knowledge identified: (a) declarative, about the world and its properties; (b) procedural, on how to do things; and (c)

metacognitive, about one's own knowledge, skills, and abilities. All three are important for they are not only apparently entered, organized, and stored differently in memory, but are stored in a number of possible representational forms (McGilley, 1994, p. 5). Experts and novices are differentiated in a knowledge domain not only through the amount and origination of knowledge, but also by what is chosen to be represented in the first place. Novices connect pieces of domain knowledge in terms of surface-level features, while experts organize information in terms of deeper level, conceptual features (Chi, Feltovich, & Glaser, 1981).

The beginning of learning theory as applied to memory problems occurred in the 1870s with work performed by Herman Ebbinghaus (1885). He used the study of nonsense syllables as the means of investigating learning. Hundreds of similar studies have been undertaken since his pioneering work. These studies were oriented in such a fashion that the learning was contrived (or forced), the most difficult type of learning situation. What became apparent quickly was that learning and/or memory was easiest when external control was relaxed, when individuals were permitted to take charge of their own learning: more simply, learning became prolific when it was unfettered in any way, when it was not forced (Holt, 1964, p. 42). Since memory involves experiences in one form or another, the entire process became one of experiential learning. Such learning or memory activities involves four adaptive learning modes (Kolb, 1984): (a) concrete experiences, (b) reflective observation; (c) abstract conceptualization; and (d) active experimentation. The basis of the learning/memory process lies in the

transactions among those four adaptive modes and the ways they are forced to interact as material is assimilated. Knowledge stored in the brain results from the combination of experiences for the individual. This is transformed into a viable memory trace.

The environment plays a premier role in such experience/transformation relationships. Several types of environments are possible:

(a) affectively complex situations: cases where the emphasis is on experiencing what is actually to be studied or investigated. Learners would engage in activities that simulate the world conditions, with the information generated most often of current or immediate use;

(b) perceptually complex situations: ones where the primary goal is to understand something, to identify relationships between concepts, and the like. The learner is encouraged to view the topic matter from different perspectives and in different ways;

(c) symbolically complex situations: ones where the learner is involved in trying to solve a problem for which there is usually a right answer. The information is often abstract, in that it is removed from the present, and the learner is guided and constrained by externally imposed rules of inference, which need to be recalled via memory;

(d) behaviorally complex situations: those where the emphasis is upon actively applying knowledge or skills to a practical problem. Here completing the task is essential.

Learning environments vary in the degree in which they are oriented to any of the four pure types. In fact, quite often the learning arena is a mixture of the above styles.