EFFECTS OF LEVELS OF PROCESSING INFORMATION ON RETENTION OF LEARNT MATERIALS AMONG SENIOR SECONDARY SCHOOL STUDENTS OF JALINGO LOCAL GOVERNMENT AREA OF TARABA STATE.

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A THESIS SUBMITTED TO THE SCHOOL OF POST-GRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTERS DEGREE IN EDUCATIONAL PSYCHOLOGY, DEPARTMENT OF EDUCATIONAL PSYCHOLOGY AND COUNSELLING,AHMADU BELLO UNIVERSITY ZARIA.

JANUARY,2014

DECLARATION

I hereby declare that this thesis has been written by me and it is a record of my own research work. The topic has not been presented in any previous study for higher degree. All quotations are indicated in quotation marks and the sources of information are dully acknowledged by means of references.

Sign ---------- ----------
Godwin Augustina Date

CERTIFICATION

This thesis entitled “effects of levels of processing information on retention of learnt materials among senior secondary school students of Jalingo local government area of Taraba state” by Godwin, Augustina meets the requirements governing the award of the degree of Masters of Education in Educational psychology of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to the blessed memory of my dearly beloved mother, Mrs Philomina Godwin Yahaya who is a role model to us in the family.

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ABSTRACT

This research work was carried out to find the effects of levels of processing on retention of learnt materials. Four hypotheses were formulated to investigate the effects of levels of processing information on retention of learnt materials among senior secondary school students of Jalingo L.G.A. Being a quasi-experimental study, a sample of two hundred students (SS11) wasselected from a population of 6,390 senior secondary school students of five Government Day Senior Secondary School students inJalingo Local Government Area of Taraba State. A simulated before-after quasi-experimental design was used. The control group was pre-tested while the experimental group was given treatment which involved inducing them to process chosen learning materials at the three levels of processing and a post-test followed immediately. The result was analyzed using different statistical tools such as means,independent sample t-test and univariate analysis of variance. The result indicated that the three levels of processing have significant effect on retention, (F=9.217, P=.001). The deepest/semantic level had the highest level of retention followed by the deeper level and lastly the shallow level. At the deeper and deepest levels, the experimental group scored higher than the control group whereas at the shallow level even though it had a significant effect on retention did not differ from the retention level of the control group. The major finding in this study therefore follows the trend that the deeper the level of processing the better the retention. Other findings indicated that males and females process learning materials in more or less the same manner (t=.238, P=.812), Science studentsdiffered significantly in retention level from the Art students (t=2.741, P=.007). The different ability groups of students differ significantly from each other in their retention levels (F=135.142, P<.001). Following all the findings in this study, it was suggested that teachers should guide learners to process learning materials at the deepest level, students should be taught with instructional aids and examples to enable them make association, that is, thinking of one thing that will bring the other to mind. Also, learning materials should be developed and arranged in a way that fosters semantic processing.

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ABBREVIATIONS

LTM – Long term memory

STM – Short term memory

OPERATIONAL DEFINITION OF TERMS

Deeperlevel – itis the level of processing information where encoding takes place by paying attention to the sound of a given item or word.

Deepestlevel – it is the level of processing information where encoding takes place by paying attention to the meaning a given item or by making associations.

Levels of processing – it is a model of human memory that proposes three different levels of processing information.

Retention – this is the storage of learning over a period of time known as retention interval.

Shallowlevel – it is the level of processing information in which encoding takes place by paying attention to the orthographic/physical features of a given item or word.

CHAPTER 1

INTRODUCTION

1.1 Background to the study

Education is seen as the backbone of any nation. It is the means by which cultural values, skills, habits and knowledge are transferred from one generation to the next. The importance of education to the general well-being of mankind cannot be overemphasized. Education is a fundamental human right that is accorded to all human beings solely because they are humans. Education is internationally accepted now as a catalyst for development. It is this recognition that led many governments of the world including FGN to become committed to ensuring that all their citizens have access to quality education. In Nigeria, the educational philosophy and methodology were adjusted to match the ideals and challenges of changing economic and social structure of modern society. Education ensures the efficient usage of a nation's natural resource, it creates a democratic society, enlightened people, strong and productive human resource. It produces professionals and effective working class members of the society (Abdulai,2010).

All forms of education – formal, informal, non-formal and vocational training are all vital in making education all embracing. In the formal type of education in Nigeria, a child can start from pre-primary, primary school to the secondary school then to the tertiary institution. How a child goes through each level is crucial in determining the end result of the entire experience in a child's life.

The secondary education is very important because it builds on the foundation laid in the primary school and then becomes a solid foundation for the tertiary level of education. In Nigeria, the secondary education (Post Basic Educ.) is the education children receive after successful completion of nine years of basic education certification examination. It lasts for three years. The Post Basic Education is meant to prepare young Nigerians with specific

skills for self-reliance. It is to give students opportunity for education at a higher level. The diversified curriculum is aimed at meeting the needs of students according to their different talents, opportunities and future roles. It is seen as means of providing manpower in various professional fields. The curriculum of the senior secondary school shall consist of science studies, technology studies, humanities and business studies. The compulsory subjects are English language, general mathematics, computer studies, trade subjects with entrepreneurial studies and civic education (Christian and Islamic Religious Studies). Government welcomes other bodies in providing Post Basic Education at set standards. The set teacher-pupil ratio is 1:40. Regular supervision and inspection of schools shall be carried out by government to ensure that the approved curricula are being adhered to and that there is conformity with the National Policy on Education. (NPE,2008).

The Federal Government of Nigeria has put in commendable efforts towards improving the standard of education in Nigeria. But despite the efforts made, the standard of Education in Nigeria still seems to be poor. This can be seen in the mass failures in public examination. The minister of Education recently decried the poor quality outcome from education and the continued decline in the number of those who pass from five credits and above including maths and English in the nation at large. She said this while declaring open the 2012 National conference on Examinations in the past years in Abuja. She said that in 2011, only 30.9% and 8.06% got five credits and above in WAEC and NECO. In 2012, 39% and 31.58% got five credits and above in WAEC and NECO. (Online Editor, Osundefender, 2012). From the Taraba State Ministry of Education, the summary of the WAEC results in the last five years shows that only 8.7% in 2008, 10% in 2009, 8.3% in 2010, 15% in 2011 and 25% in 2012 passed the examination.

Many factors have been established as responsible for such mass failure in public examination- shortage of qualified teachers and the presence of unqualified teachers who are

unable to motivate learners to learn, inappropriate use of teaching materials and teaching methods and poor working condition of teachers themselves. (Ogunleye, 2013). There is shortage or complete absence of facilities (infrastructure) such as befitting classrooms, properly equipped laboratories, adequate furniture, modern day libraries with internet facilities and computers. Peer group, parents and society also make students fail exams for example by making them speak pidgin English, not encouraging them to take time to study and parents choosing careers for their children. (Salman, Mohammed, &Ogunlade, 2011). The social media is a factor where students spend a lot of time surfing the internet, watching football and African movie magic rather than read their books. The corner-cutting format of English used in emailing and phone texting which breaks grammatical and punctuation rules to enhance speed in communication is another factor. Some students are lazy and only want to be spoon fed. They do not take time to study and practice what they have learnt. This leads to poor preparation and exam malpractice. (Odia&Omofonwan, 2007,Okoh 2011). Students do not process what they have learnt properly as is seen clearly during exams when student cram their notes and answer questions word for word. Such students quickly forget what they have learnt because there was no understanding of what was crammed. (Ogunleye, 2013).

A core variable that makes learning possible is human memory. All learning experiences are first encoded through the sensory memory. Processing, retention and retrieval of what has been learnt is only possible through all the memory processes. As vital as human memory is in enabling learners learn, learners still battle with its imperfection in their daily life. Normally less important things are forgotten and only the important ones are kept in the memory bank. But sometimes, for various reasons, even some important things are forgotten. The levels of memory processing model proposes an explanation to this phenomenon.

The levels of processing model can be a big eye opener as to why students forget a large chunk of what they have been taught. It holds that the greater the processing of

information during learning or memorization, the more it will be retained and remembered (Santrock 2004). According to the theory, information can be processed at the shallow, deeper and deepest levels. The deeper the processing of information, the more durable the memory trace. The basic idea is that memory or the ability to recall is determined by depth of processing.The levels of memory processing model proposes for example that even if a word is meaningful but if it is looked at only at its physical appearance, it will be easily forgotten and difficult to remember. If attention is paid to the sound of the word, it increases the chances of retaining and remembering the word at a higher retention level than the orthographic stage. The levels of processing theory proposes a way of encoding learning materials so that retention is higher and retrieval is made easy. It holds that processing learnt materials according to meaning is the best method of learning because it leads to better retention and higher retrieval. The level of retention depends on how information is processed. (Mangal 2010, Standen 2011). Would it be right then to speculate that lack of proper processing of learnt materials is one of the factors contributing to massive failure in public exams?

Learnt materials need to be retained in order to be retrieved (recall) later. Learning is the primary condition for retention and recalling. If there is no learning there would be no retention and recall. It is in view of this that this study seeks to assess the effects of levels of processing on retention of learnt materials.

1.2 Statement of Problem

In a formal type of education, most of the teaching and learning activities take place in a classroom. For some topics in different subjects, a teacher might decide to take the learners out of the class in to the school field, laboratory, or even the community in which their school is situated to learn. The different methods teachers adopt to introduce and present learning materials provide learners with the opportunity to process and retain what they see, hear and experience for later retrieval. Some learning materials, may be because of the instructional aids and the presentation method that accompany them, are so striking that learners process them with utmost understanding. But sometimes for various reasons, learners assimilate learning materials they are exposed to without understanding the meaning, as a result, retention, retrieval and application to real life situation may not be very effective. Different types of information in the learning process require different methods of encoding. For example, to learn names and dates and formulae associated with certain facts, one may have to memorize them as they are. But for assimilating knowledge of concepts and different contents of a subject, one may need to employ a different method like trying to understand the meaning of a concept rather than just memorizing it. While some learners try to understand what they learn and express it in their own words, other learners base the encoding of what they learn more on memorization method rather than understanding. They encode lesson contents presented to them as they are and reproduce them in the same way during examination word for word, whether they understand the content or not. Encoding learnt materials in this kind of way involves a level of processing that is poor and consequently leads to poor retention and difficulty in later retrieval. Such situations can be seen in results of standardized examinations like WAEC and NECO.

In recent years, results of WAEC and NECO show massive failure of candidates. Only a small percentage is able to pass the required standard and so it is no longer a strange

phenomenon today to see many students failing their final examinations in the secondary school. For example, the summary of the WAEC result in Taraba state of those who passed the exams in the past years is presented below:

Year	**Percentage that passed**
2008	8.7%
2009	10%
2010	8.3%
2011	15%
2012	25%

The summary of NECO results of some selected schools in the three zones of Taraba State show that only the percentage given under each subject passed:

Subject	**2008**	**2009**	**2010**	**2011**	**2012**
English	52%	8%	20%	11%	32%
Maths	35%	6%	13%	26%	40%
Economics	49%	3%	21%	29%	48%
Geography	60%	9%	25%	14%	36%
Biology	43%	13%	40%	9%	40%
Agriculture	48%	10%	23%	14%	40%

(Ministry of Education Taraba State).

From the summary of the results above, the general performance seems to be below average because even though the performance in some years is better than others, the overall average performance of each year is not up to 50%. This poor performance as corroborated in the two tables above cannot be said to satisfy the aspiration of the government for secondary education.

In view of the above, some questions agitate the mind of the researcher: How do learners process and store what they have learnt? Do learners understand and focus on the meaning of what they have been taught? At what level of memory processing do the secondary school students of Jalingo local government area process what they have been exposed to in the teaching/learning process? What are the effects of levels of memory processing on the students' level of retention? How does the level of memory processing compare between males and females, between science and Arts students and between high and low ability students?

Providing answers to all the questions posed above form the thrust of this study which is an investigation into the effects of levels of memory processing on retention of learnt materials.

1.3 Objectives of study

The main objective of this study was to investigate the effects of levels of processing informationon retention of learnt materials among senior secondary school students in Jalingo Local government area of Taraba State. The study focused on the following specific objectives to determine:

i. the effects of levels of processing information on retention of learnt materials among senior secondary school students in Jalingo Local Government Area.
ii. the difference in retention between male and female students of the senior secondary school students in Jalingo Local Government Area.
iii. the difference in retention between Science and Arts students of the senior secondary school students in Jalingo Local Government Area.
iv. the difference in retention among high, average and low ability students of the senior secondary school students in Jalingo Local Government Area.

1.4 ResearchQuestions

1. Is there difference in retention of learnt materials between the experimental and control groups?

3. How do male students compare with female students in retention of learnt materials?

4. How do science students compare with Arts students in retention of learnt materials?

5. How do high ability students compare with low ability students in retention of learnt materials?

1.5 Research Hypotheses

The following research hypotheses were framed to give focus to the study and the hypotheses are non-directional. The hypotheses would be tested at 0.05 level of significance.

Ho1. There is no significant difference in retention of learnt materials amongthe three levels of processing information.

Ho2. There is no significant difference in the retention of learnt materials between male and female students.

Ho3. There is no significant difference in the retention of learnt material between science and Arts students.

Ho4. There is no significant difference in the level of retention among the high,average and low ability students.

1.6 Basic Assumptions

For this particular study, it is assumed that;

1. Levels of processing influence retention of learnt materials.
2. Gender and subject of study affect the processing and retention of learnt materials.
3. Level of ability affects level of retention.

1.7 Significance of the Study

This study will be important to teachers. It will educate teachers on the importance of processing learning materials according to their meaning. This knowledge will help them to always call their students' attention to the need to understand the meaning of what they are learning or be able to create association between what they learnt and something else. It will help teachers to present lesson contents and include learning activities at a depth that will give learners the opportunity to explore the topic in depth and get a sense of what the meaning, important and organizing ideas are. The result of this study will give the teachers a clearer view of what the learners are capable of in terms of their ability to retain learnt materials especially when they study with awareness to understanding what they studying. It will create in the teachers a better awareness of the learners' capabilities. It will enable teachers select materials in such a way that enables learners benefit maximally from the teaching and learning going on in schools. This study will clearly illustrate to teachers the most effective ways of strengthening retention and recall memory in learners.

This study will be significant to educators and curriculum planners in that it will enable them set objectives that will enable teachers and learners focus on the meaning of or understanding what is being taught and learnt in the teaching/learning process. It will guide them in their choice and arrangement of learning materials for both learners and teachers. It will enable them distinctly elaborate learning materials so as to enable teachers set lesson objectives and ask questions that foster retention and retrieval through semantic processing. It will enable them design the content of the curriculum in such a way that will enable learners easily organize knowledge in meaningful ways.

. This study will benefit learners indirectly because by enabling curriculum planners adjust the content design of what learners and teachers undergo in their academic formation, they are empowering learners to enhance their retention level by proper processing.The

findings in this study will enable curriculum planners and teachers give learners enough time to explore what is learnt at depth so as to grasp the meaning. The need for semantic processing of all that is learnt will be clearly expressed by teachers during classes and in the way the objectives are set, this will propel learners to always focus on the meaning of any given learning material presented to them. Focusing on semantic processing will require learners to set aside quality time to further process and store what they have learnt. Furthermore, this study will enhance effective teaching and learning.

This study is significant to future researchers who wish to carry out similar studies because it will assess the claims of the levels of processing theory among senior secondary students in Jalingo, thereby adding to knowledge and its findings will point out areas not yet clearly understood, creating a vacuum to be filled in the future. This study will be significant to school management and the community because by building up the performance of learners, the community is being empowered and the school management made more efficient. Learners are the central focus in the teaching/learning process, this study will benefit them because they will be induced to process learning materials properly. It will show how human beings of different sexes, taking different subjects process information.

1.8 Scope and Delimitation

In terms of geographical location, this study was restricted to Jalingo Local Government Area of Taraba State. The study was also delimited toinvestigating the effects of levels ofprocessing information on retention of learnt materials among secondary school students only but did not attempt to find out the roles of the working memory model and the multi-store model of memory on retention and academic achievement. The test that was used was formed from the English language senior secondary school syllabus of the SS1 class. In this regard, only senior secondary school students (SS 2), who have been exposed to the SS1

syllabus were used as subjects of this study. The 2012/2013 academic session was used for the study.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.01 Introduction

This chapter focused on relevant literature about the topic- "Effects of levels of memory processing on retention of learnt materials." The critical review of literature on current views and research work on this topic is presented under the following sub-headings:-

- Conceptual framework
- Theoretical framework
- Theories related to levels of processing information and retention
- Retention
- Factors affecting information processing
- Gender and age factors
- How to facilitate retention of learnt materials
- Review of empirical studies
- Summary

2.02 Conceptual Framework

Human memory was thought of in the 1960s by Atkinson and Shiffrin in terms of stores that hold different types of information for different lengths of time. The general knowledge was that information was encoded through the sense organs, the information persisted briefly in the sensory memory. If attention is paid to any information, it moves to the STM and the LTM. Researchers however, had problem with this notion of memory, they didn't find it to be adequate enough.

Craik and Lockhart (1972) developed serious reservations about the continuing usefulness of the stores metaphor. They held an alternative view in which discrete stores were replaced by a continuum of processing varying from shallow analyses to deeper semantic

analyses. They postulated that memory was the record of the operation carried out during perception and comprehension and that deeper level of processing was associated with longer lasting memory traces.

The levels of processing account generally proposed that the level at which an event is coded in the cognitive system determines later recall and recognition for that event. It postulates that processing efforts affect the duration of the` memory trace. Retention of learnt materials in the levels of processing framework refers to the idea that encoding superficial representations of print such as orthography, results in less durable memory traces than "deeper" or more elaborated encoding at a semantic meaning level. Levels of processing states that the more analysis an item receives the better it will be recalled.

The levels of processing approach is essentially concerned with the role of coding in learning, the relationship between the manner in which material is processed and the probability that it will subsequently be remembered. As such, it is primarily a theory of long term memory, it does assume a primary or short term memory system that actually does the coding but details of it are left unspecified (Baddeley, 1999).

In an influential paper written in 1972, Craik and Lockhart suggested that the amount of information retained in long term memory depends on how "deeply" it is processed during learning. The concept of depth was based on a perhaps oversimplified view of the way in which we process information. It assumed, for example that written words are first processed purely in terms of their visual characteristics, that these are then turned in to a representation of the sounds of the words, and that these subsequently evoke the appropriate meaning. In judging whether a word is written in upper or lower case letters, there is no need to process information at any other than the purely visual level, such "shallow" processing is assumed to give rise to a relatively impoverished memory trace which will be of little assistance in the task of recalling the words. In order to decide what the word sounds like, however, it is

necessary to go beyond the superficial visual analysis and attend to its sound, this is assumed to give rise to a rather more robust and useful trace. However, processing the word in terms of its meaning requires one to go beyond this stage, creating a richer and more durable memory trace (Baddeley 1999).

Retention is the storage of what has been learnt or experienced. It is the ability to retain facts in memory. It is the condition of retaining something. It is the ability to keep, store, hold and remember ideas and facts.(Wittig,2001). There are three types of storage – the sensory storage, short term storage and the long term storage. All the three stores help human beings encode, store and retrieve information. Retention can be measured through recognition, recall and re-learning.

2.03 Theoritical framework

Memory

The storage and retrieval of what has been learnt or experienced is memory. The ability or power of our mind to store the past experiences of learning and utilizing them at a later stage is known as memory. Ryburn in Mangal (1998) defines memory as "the power that we have to store our experiences and to bring them in the field of consciousness sometime after the experience has occurred, is termed memory". Memory is thus regarded as a special ability of our mind to conserve or store what has been previously experienced or acquired through learning and then, at some later stage to enable us to make use of its reproduction.

The first memory process is encoding – the transforming of information so that the nervous system can process it. You use your senses to encode. After information is encoded, you store it and that is the second process. This is the process by which the information is maintained overtime. The third process is retrieval. It occurs when information is brought to mind from storage. The way information has been encoded and stored will determine the ease with which it is retrieved (Kasschau 2003).Memory is like a store house where information of different kinds is kept for different time durations. The human being takes in many bits of

information through perception and depending on the kind of attention given to the information taken in, some fade away quickly while others are pushed to different store houses. These bits of information in different store houses enable the human being perform certain things that make him unique and different from other animals that show traces of memory.

The human being is able to remember things learnt in the past, connect it with the present and use it in problem solving both in the present and future. As a result of this ability, the human being is very much aware of the things going on around him and he doesn't have to learn the same thing again and again which would have been the case if the human being does not have memory. George Miller (in Balarabe, 2004) shows clearly in his work that there is a limit to the amount of information a human being can keep in the conscious mind at any given time that is the magical formula of seven plus minus two items. This confirmed and extended the earlier work of Ebbinghaus (1885). Memory enables the human being to generate new learning and verify things learnt in the past. The human being is able to compare past learning with present learning because of their ability to retain what they have learnt.

2.03.1 Models of Memory

Several theories and models have been devised by psychologist to explain how memory works. Some of these memory models are discussed below.

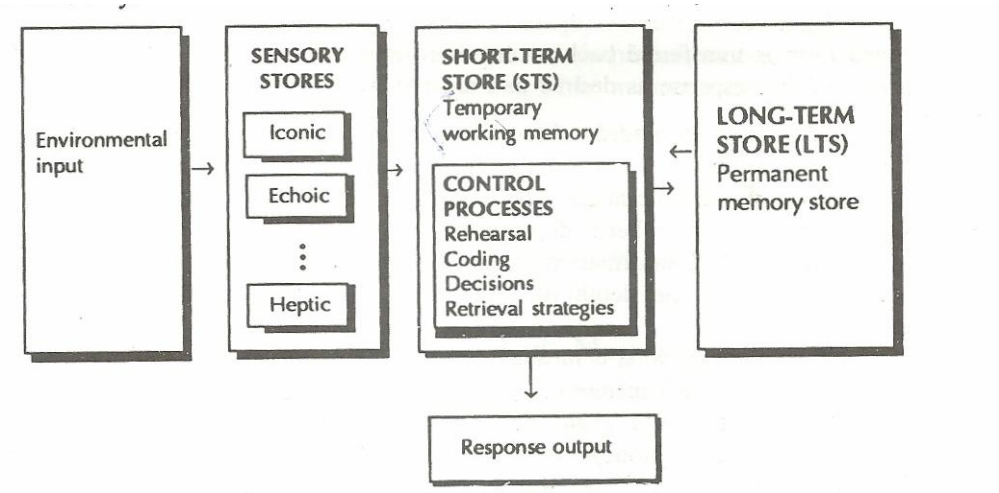
2.03.2 The Multi-Store Model

This model is popularly known as the Atkinson – Shiffrin memory model. This model was proposed in 1968 by Richard Atkinson and Richard Shiffrin as a proposal for the structure of memory. The multi store model proposed that human memory involves a sequence of three stages: The sensory store, the short term store and the long term store.

The process of memorization starts with the interaction of one's sense organs with environment (Mangal, 2010). Through perception, sensory information travels to the brain where it is interpreted. The sensory information is stored with a very brief period from less than a second to two seconds. According to Atkinson and Shiffrin, there seems to be a sensory store for each sense but however, only the visual and auditory storage systems – referred to as iconic and echoic memory respectively have so far been developed.

The sense organ has a limited ability to store information coming from the environment. The information is retained in an unprocessed way for a very snappy period of time. The sensory memory is a very short term buffer where senses store what they have received from the environment in roughly its original form but it does so only for a brief period of time. It takes at most a few second for information in the sensory register to spontaneously decay or fade away (Donahoe&Wessells 1980).

At this stage of memory, the information that is stored is simply some sensory representation of the external stimuli that have impinged upon our receptors. During the sensory stage, we take in far more information than we can efficiently process (Ellis, 1979). Thus, sensory memory is a large capacity system where so much information is held for only a brief period of time and we can attend to only a fraction of the total amount of the information received in this system, while others decay extremely fast. The duration here is between 0.25 to 2 seconds. The diagram below is a model of memory storage.



The sensory memory consists of the following store:

a. The iconic store: This is where *Visual* images are kept for a brief period of time.
b. The Echoic Store: This is where auditory information is kept for a brief period of time.
c. The Heptic Store: This retains the information from the physical senses such as senses of touch and internal muscle tensions to move to the next memory store, while those we don't pay attention to decay rapidly.

The next level of memory is the short-term store. This was referred to by Williams James in Norman (1978) as primary memory. It is defined as the capacity for holding a small amount of information in mind, in an active, readily available state for a short period of time. Recalling a telephone number that has just been dictated on radio, without writing it down, after a few seconds of dictating it occurs at the STM state. If the recalling is attempted after being interpreted by another factor, one may not be able to recall it correctly. The STM's duration span is 15-30 seconds unless the information is rehearsed and its content decays spontaneously over time. It has the capacity of seven plus minus two (7±2) items. The short term store takes the form of a buffer which has a limited capacity and once its capacity is reached, old information is displaced in order to take in new ones.

The short-term memory stage however may hold larger amount of information by a process called Chunking. Chunking is a process by which we expand our ability to remember things in the short term store. It is a process in which a person organizes information into meaningful groups. Another way of retaining information for a relatively longer period of time at STM is by periodically repeating and rehearsing the information, this can help transfer the information to the next level of memory.

The Long-term store: This has potentially limitless capacity and duration. Williams James in Norman (1978) referred to it as secondary memory, it is the ability to remember over long periods of time. There is little decay in the long term store. Even though the distinction between STM and LTM is not marked by a clear sharp division, long term memory deals with information that has entered more permanent storage system. By rehearsing items, we can process information sufficiently so that it enters long term memory. LTM provides lasting duration of retention of information, from a minute to a life time. Memory may also be transported directly from sensory memory to LTM if it receives instant attention.

The three different stores are actually not separate in operations, information flows continuously from one store to the other.

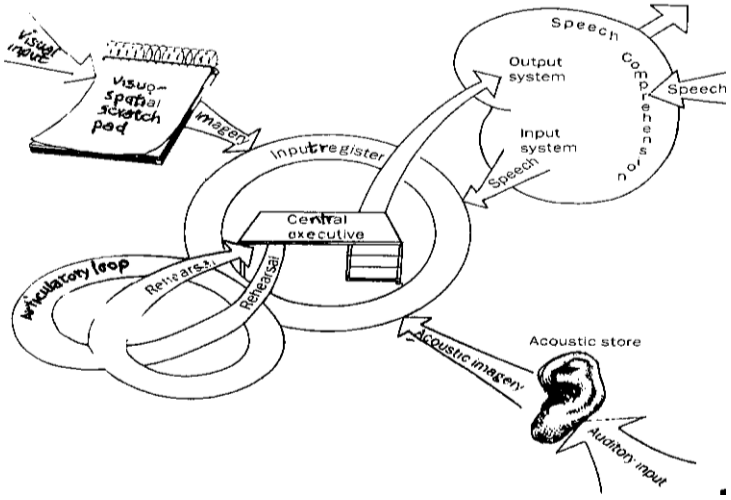
2.03.4 The Working Memory Model

Although Akinson and Shiffrin's memory model has been challenged, many researchers still believe that there is a fundamental difference between immediate memory and long-term memory. The working memory model was proposed by Baddeley and Hitch (1974, cited in Hayes, 1994) and it is otherwise known as Baddeley - Hitch model. For them, it is more useful to look at the immediate memory as a kind of working memory, used to deal with a particular problem or set of information. While explaining this model, Smith and Kosslyn (2007) described human memory to be like the computer in which we have two

means of storing information: the hard disk and the random access memory (RAM). The hard disk stores information permanently in a more stable and reliable form. All the software programs, data files and the operating system of the computer are stored on the hard disk. To use this stored information, you must retrieve it from the hard disk and load it into the RAM, which displays on the desktop. The information stored in the hard disk is like long term memory while RAM corresponds to working memory.

After information has been located by a search of long term memory or from the environment through the sense organs, it must be gathered together and organized in some useful forms. The process of assembling and organizing the information takes place in the working memory (Ellis, 1979). The working memory is an active process where information is sifted, organized and prepared for recall. The working memory model is an alternative to the working of STM in multi store model. But rather than STM being a single inflexible store, Baddeley and Hitch suggested that the STM was made up of several subsystems, each having a specialized function, thus, forming the working memory.

The working memory consists of the central executive, the visuo-spatial scratch pad, the articulatory loop, the acoustic store and the input register as can be seen in the diagram below:-



The central executive can deal with most kinds of information and several subsystems. The central executive would be used for cognitively demanding tasks, which require a lot of attention. The central executive has a limited capacity like the older concept of STM, it cannot handle very much information at a time. But unlike the STM that is passive, the central executive has an active cognitive mechanism. The other components are seen as minor systems being used by the central executive for particular purposes. The concept of working memory is a kind of summary of the immediate memory systems which are being used during a given task (Hayes, 1994). So, for instance, in terms of understanding speech, apart from the central executive there would be one subsystem dealing with non-verbal information, an output system concern with what the person has recently said and an input system concerned with the speech that they have recently heard.

The visuo-spatial scratch pad is a kind of coding system which receives input and codes it into visual or spatial imagery. Of the two, spatial encoding seems to be more significant or at least, Baddeley and Lieberman in Hayes (1994) found that people tend to use it more than visual coding for their initial reception of information.

The articulatory loop involves a kind of internal voice, as if words are being spoken sub-vocally and which is seen as being very closely connected with the formation of normal speech. The articulatory loop is used to add to the amount that the central executive can store, by being used to rehearse verbal input. The idea of articulatory loop can be used to make sense of the previous experimental evidence which showed how important rehearsal was to short-term memory. According to working memory model, rehearsal of information would be taking place in the articulatory loop rather than in the central executive.

Another major component of the working memory system is an acoustic store, in which auditory information seems to be coded directly, independent of the articulatory loop. Baddeley et al in Hayes (1994) showed that information which was presented acoustically

was not affected by articulatory suppression, it seemed to affect only information which was shown to the person visually.

A fifth component of the working memory model is an input register. This operates as a kind of 'inner ear' which represents the most recent words which the person has heard- so the workings of the input register can account for recency effect findings (Hitch in Hayes, 1994). Hitch argued that this isn't just a passive 'echo' of what has been heard, rather, it is a representation of the words which has been analyzed a little- at least into meaningful units so that the information is prepared for later semantic processing.

The working memory model, then, involves several different components, each of which serves a different function or is involved with different types of information.

2.04 Theories Related to Levels of Processing and Retention

2.04.1 The Schema Theory

Anderson (1977) a respected educational psychologist, developed schema theory. This learning theory views organized knowledge as an elaborate network of abstract mental structures which represent what one understands of the world. The term schema was first used by Piaget in 1926, so it was not an entirely new concept. Anderson, however, expanded the meaning. Contemporary learning theory embraces schema theory in an attempt to explain how information is best encoded in the long-term memory. The theory emphasizes the nature and purpose of schemata as the fundamental elements of cognitive processing (Douchy&Bouwens, 1990 in Tan et. al. 2003).

They are prior knowledge linkages, and they influence the amount and proficiency of our learning. Research by schema theorists indicates that abstract concepts are best understood after a foundation of concrete and relevant information has been established. The general knowledge provides a framework into which the newly-formed structure can be fitted.

• Schemata are always organized meaningfully, can be added to, and, as an individual gains experience, develop to include more variables and more specificity.

• Each schema is embedded in other schemata and itself contains subschema.

• Schemata change moment by moment as information is received.

• They may also be reorganized when incoming data reveals a need to restructure the concept.

• The mental representations used during perception and comprehension, and which evolve as a result of these processes, combines to form a whole, which is greater than the sum of its parts.

Relevance of the Theory to Learning Process

Schemata are an effective tool for understanding the world. Through the use of schemata, most everyday situations do not require effortful thought which absolutely automatic thought is all that is required. People can quickly organize new perceptions into schemata and act effectively without effort. This theory would suggest that our prior knowledge can facilitate or enhance transfer of a learning task. It is also true that prior knowledge can inhibit or interfere with our acquisition of new information (Leinhardt, 1992 in Tan et. al. 2003).

2.04.2 The Network theory of memory organization

McClelland (2005), propounded a network theory of memory organization. One of the great puzzles of memory is how you file and store billions of things over your lifetime. The network theory is one of the theories that explain how we file and organize our memories. It says that we store related ideas in separate categories or files called nodes. As we make associations among information, we create links among thousands of nodes, which make up a gigantic interconnected network of files for storing and retrieving information. Nodes are

mental files that contain related information organized around a specific topic or category and these thousands of mental files are arranged in a certain kind of order called network hierarchy (Diesendruck&Shatz, in Plotnik& Kouyoumdjian,2011). A network hierarchy refers to the arrangement of nodes of memory files in a certain order or hierarchy. At the bottom of the hierarchy are nodes with very concrete information, which are connected to nodes with somewhat more specific information, which in turn are connected to nodes with general or abstract information.

In the network theory, the nodes or mental files are like thousands of cities on a map and the connections or associations between them are like roads. And so, just as you follow different roads to go from city to city, so also you go through different associative pathways to go from idea to idea. According to network theory, when you are asked a question, you look for the answer using different nodes or mental files. This idea of the network theory is partly supported by recent findings showing that the brain seems to have its own built-in filing system.

2.04.3 The Meaningful Learning Theory

Ausubel (1968) is a psychologist who advanced a theory, which contrasted meaningful learning from rote learning. In Ausubel's view,

"To learn meaningfully, students must relate new knowledge (concepts and propositions) to what they already know."

Meaningful learning requires knowledge to be constructed by the learner, not transmitted from the teacher to the student. It contains 8 primary attributes. The attributes are active or manipulative, constructive, reflective, intentional, complex, contextual, collaborative, and conversational.

Active (manipulative):

• We interact with the environment, manipulate the objects within it and observe the effects of our manipulations.

Constructive and Reflective:

• Activity is essential but insufficient for meaningful learning. We must reflect on the activity and our observations, and interpret them in order to have a meaningful learning experience.

Intentional:

• Human behaviour is naturally goal-directed. When students actively try to achieve a learning goal that they have articulated, they think and learn more. For students to experience meaningful learning, they must be able to articulate their own learning goals and monitor their own progress. Interpret them in order to have a meaningful learning experience.

Authentic (complex and contextual):

• Thoughts and ideas rely on the contexts in which they occur in order to have meaning. Presenting facts that are stripped from their contextual clues divorces knowledge from reality. Learning is meaningful, better understood and more likely to transfer to new situations when it occurs by engaging with real-life, complex problems.

Cooperative (collaborative and conversational):

- We live, work and learn in communities, naturally seeking ideas and assistance from each other, and negotiating about problems and how to solve them. It is in this context that we learn there are numerous ways to view the world and a variety of solutions to most problems. Meaningful learning, therefore, requires conversations and group experiences.

  Cognitive revolution is a school of thought that evolves from the three disciplines, namely psychology, anthropology and linguistic. Cognitivists focus their theory on

the human conscious mind, while behaviourism focuses on behaviour and psychoanalysis focuses on the unconscious mind.

- The contemporary cognitive perspective was originated from the Gestalt psychology, which was first founded by Max Weithmer in Germany. The gestaltists focus their research on human perceptions and come about with the theory of perceptual organization called the Law of Perceptual Organization.
- The Information Processing Model consists of perception, encoding, storage, and retrieval, while the 'Multi-store model' proposed by Atkinson and Shiffrin (1968) consists of three stages, namely sensory register, short-term memory and long-term memory.
- According to the schema theory, our prior knowledge can facilitate or enhance transfer of learning.
- Cognitive structuralism was founded by Piaget (1896-1980) and other constructivists such as Bruner and Ausubel.
- Ausubel proposed the rote meaningful learning. He contended that in order to learn meaningfully, students must relate new knowledge (concepts and propositions) to what they already know.
- Bruner came up with insightful learning which argued that people's understanding of objects or facts were developed through stages.
- Teacher can apply many principles suggested by constructivists such as insightful learning, meaningful learning, scaffolding, expository approach, and techniques of memorizing devices such as mind-mapping and mnemonics.

The theory chosen for this study is the schema theory. In learning, previous knowledge which is in some way related to a new topic to be presented is evoked to help learners understand better what they are about to learn. Schemata which are prior

knowledge linkages that add to proficiency in learning become very relevant and helpful in semantic processing. Existing schemata about a person's general knowledge about the world represent the semantic LTM. In processing information at the semantic memory processing level, a person is creating a relationship or a continuum between past and present events. In trying to understand a given stimulus at the present, past schemata containing various schema and subschema are evoked, and when the new schema is understood, it adds, develops or re-organizes the existing schemata meaningfully on the given topic. According to the levels of memory processing model, when the need arises for the recall of such information, it is easy because more effort and thinking went in to creating the linkage with the prior knowledge or in making association with appropriate schemata. Probably, the lack of thinking and less effort put in to processing at the shallow level does not give the information enough time to locate the appropriate schemata and be meaningfully embedded, may be that is why recall at this level is difficult and low.

2.05 Retention

Retention is thought of as the storage of learning over a period of time called retention interval. Memory includes both retention (storage) and retrieval, which involves getting the response out of storage. If for some reason the subject is unable to produce the response at the end of the retention interval, forgetting – the loss if retention or the inability to retrieve – has occurred. (Wittig, 2001)

Knowledge is acquired through perception and perception takes place through the senses. Knowledge develops if the information perceived is retained in the mind. But if the information is destroyed or fades away quickly then knowledge cannot develop. Thus, retention is the preservation factor of the mind. Whatever touches consciousness leaves

memory traces that is retained in the mind in form of images. Retention is often evaluated by using an information processing approach. Psychologists interested to represent learning functions in terms of computer programming have analyzed the learning process as an input – processing – output sequence. By knowing the stimuli to which the subject is exposed and the response the subject later makes, they hope to programme computers to stimulate the learning process and thus better understand acquisition, retention and retrieval.

2.05.1 Types of Storage

The most widely accepted explanations of storage propose three levels or categories – sensory storage, short term storage and long term storage. When measured by the retrieval of information, these also are referred to as sensory memory, short term memory and long term memory.

2.05.2 Sensory/Immediate Memory

This type of memory help human beings remember what they have perceived immediately. The time duration of this type of memory is very brief, it is such that old sensory impressions are erased completely from a person's memory as new impressions come in. This type of memory helps us to remember things that we only need to recall after a short period of time and then forget it for example, the environment first makes contact with an organism at all levels of the sensory receptors. As you go through a busy market place, you are bombarded with hundreds of sights, smell and sounds. These stimuli reach the sensory memory which holds the information for a brief period of just seconds. The human brain has video-audio recorder that automatically receives these environmental information and keeps them for just seconds or less and it is left for the individual to decide whether an incoming information is important enough to be given attention or not. The information he pays attention to moves on to other memory stores and the ones he does not pay attention to, fade away quickly, leaving no memory trace.

Human beings take in a lot of information through the senses and this is known as sensory memory. Two of such are iconic and echoic memory.

Iconic memory

Iconic memory is one of the sensory registers that allows an image to persist for about half a second after its stimulus is removed. It is when the human brain remembers an image after it has been briefly shown the image. Iconic memory refers to the memory of sight. Iconic memory occurs when a visual stimulus produces a brief visual memory trace called an icon. According to Plotnik and Kouyoumdjian (2008), iconic memory is one of the sensory memories where visual images are automatically held for a quarter of a second or less as soon as you shift your attention the information disappears.

Many times a day, we blink our eyes and during those eyes blinks, our eyes are completely closed or blind but we do not feel our eyes closed or blind because the images our eyes look at last are still being stored in the iconic memory. That is why even when we open our eyes after a blink, we don't feel like our world disappeared completely into darkness because we continue to see what we saw before blinking our eyes. In iconic memory test, the human brain does not have enough time to decide what to process. The transference of information from the eye to the brain is preserved long enough for the eye to move to the next point.

Echoic Memory

According to the Oxford dictionary of psychology, echoic memory is one of the sensory registers that allows auditory images or information to persist for seconds, making speech intelligible and enabling sound localization with the use of the binaural time differences between the arrivals of the sounds to both ears. Echoic memory is one of the sensory registers, a component of short term memory that retains auditory information. This sensory store can store a large amount of auditory information for a short period of time. The

echoic sound resonates in the mind and it is replayed for a brief period of time after the presentation of the auditory stimuli.

The temporary retention of raw, unprocessed auditory information is important in audition as it is in vision. Human beings are able to retain unprocessed auditory information and this type of sensory memory is known as echoic memory. Echoic memory occurs whenever we hear something it is a sensory memory that holds information from 1 – 2 seconds. For example, suppose you are absorbed in reading a book and your friend says something to you. You stop reading and ask your friend "what did you say?" and you realize that immediately after you ask the question, you can remember what our friend has said. This is because what your friend said is still in echoic memory. Echoic memory enables us play back some sounds and also know that certain sequences of certain sounds form words. Some researchers say that the length of echoic memory increases as a child grows into adulthood. Following Sperling's procedures on iconic memory, so many researches were interested in testing the same phenomenon for the auditory sensory store. Echoic memory was measured by participants being asked to repeat tones, words, and syllables presented to them usually requiring motivation and attention. The most famous partial report task was conducted by presenting participants with an auditory stimulus in left, right and both ears simultaneously.

2.05.3 Short Term Memory

As the name implies, STM span is short but it lasts longer than the sensory memory. This type of memory is also temporary. The information that reaches the STM can last for up to thirty seconds even if it is not rehearsed. However, rehearsal of any information by an individual will make the information reside in the STM indefinitely (Mangal 2010).

In the STM human beings can keep up to seven plus minus two magical number even though there are exceptions because some people can remember more than the magical

number given by George Miller by a process known as chunking. For example instead of trying to remember 142356879102 individually, you chunk it as 142,356,879,102.

Memory has three stages – Encoding, storage and retrieval. To encode information in the STM, you have to attend to it, you have to pay attention to it by selecting what you need and those that you don't pay attention to will not enter the STM. Information that we don't pay attention to are forgotten. Encoding means that information is deposited in a certain form in the memory. Research indicates that we encode information into the STM visually that is by keeping a mental image, acoustically, that is by keeping the sound or semantically that is by keeping some meaningful association we have with the information in question. However we seem to favour acoustic coding when we try to keep information by rehearsing it. Visual coding of verbal materials fades quickly and is dominated by the acoustic code. Codes linked to other senses, such as touch and smell, can also be used to encode short term memories.

Storage

STM has a limited capacity of seven plus minus two items for most adults and this constancy has been known since the earlier days of experimental psychology. Ebbinghaus who began his experimental study on human memory since 1885, gave a limited number of seven items which was later in 1956 confirmed and extended by Miller to magic number seven. Psychologists determined this number in repeated experiments with their subjects using letters, words and numbers. Once the STM has reached its capacity, any new incoming information, displaces one of the old information already stored in the STM and this causes forgetting. Forgetting in the STM can occur simply because of decay even if no new information follows after a long time. Rehearsing such information will strengthen the memory trace again.

Retrieval

Information in the STM is retrieved without having to "dig for it". Retrieval requires a search of STM, where an item is examined at a time in a very fast speed. In experiments carried out by Sternberg in Atkinso, Atkinson and Hilgard, 1979), subjects showed that a search goes on while trying to locate the required information in the STM. Subjects were given a memory list and a probe. The duration of time taken to answer 'yes' or 'no' to the probe showed how fast the search is in the STM with appropriate processing and sustained rehearsal of information in the STM may eventually get into the LTM.

2.05.4 The Long Term Memory

The LTM is limitless in its capacity to store information. Information properly rehearsed in the STM moves to the LTM where it can virtually remain indefinitely. The LTM codes information according to meaning, pattern and other characteristics. It helps us to remember things on a relatively permanent basis like one's birthday, father's name, date of marriage, year of graduation from the university etc. these are typical examples of information found in LTM.

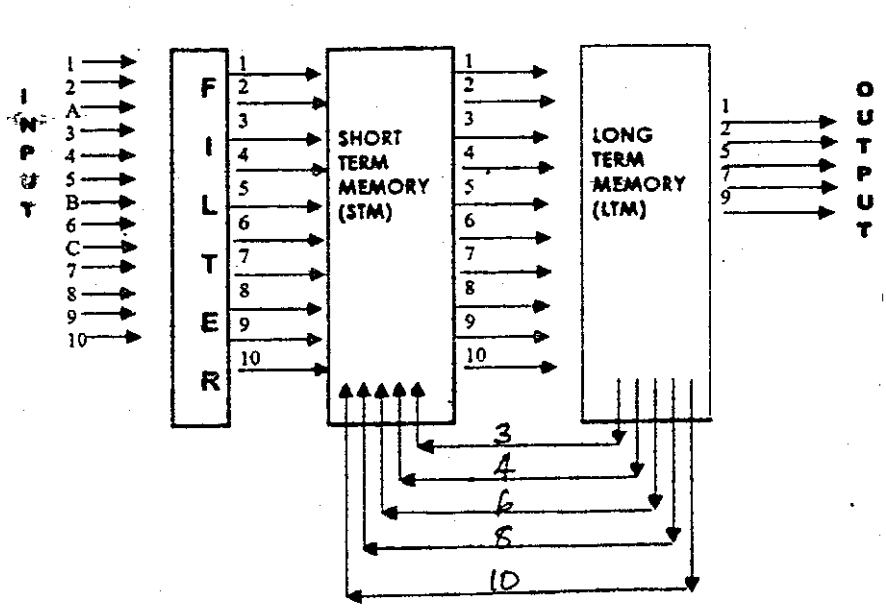
Encoding in LTM tends to be based on meaning. So adding meaningful connections between different information can be a powerful memory aid. Coding in the LTM can be through memorization as is the case with reciting poems. We can also use acoustic coding, taste and smell coding in the LTM. We prefer meaningful coding in the LTM and acoustic for STM but other codes can be used as well. Coding by meaning produces the best result as was clearly seen in the experiment of Craik and Tulvin (1975). Elaboration of information makes remembering even better.

Storage and Retrieval in the LTM

Storage and retrieval have to be considered together in the LTM. Retrieving an information fails due to inability to access or locate a stored information rather than loss of the information. That is poor memory may reflect a retrieval failure rather than a storage

failure. There is no information loss in the LTM, with retrieval cues and sometimes under hypnosis, people are able to remember information that has been forgotten. The better the retrieval cues the better our memory and that is why we do better on a recognition test than on a recall test where there are no retrieval cues (Tulving in Atkinso, Atkinson And Hilgard 1979). To enhance retrieval, there is need to organize the information in storage and to also ensure that the context in which we retrieve information is similar to the context in which we encoded it.

To understand the functioning of the STM and the LTM, it is useful to consider the Broadbent model below:-



Broadbent Model of Memory Mechanism

(From Mukherjee, 2002)

The function of the filter in the diagram is to enable one to filter the relevant information from the irrelevant information that come in from the very many information received through the senses. The irrelevant bits of information are represented as A, B, C, which are not sent to the STM since attention is not paid to them. Due to the limited capacity of the STM, it is able to process only a few items of information at a time. For this reason,

there is the feedback or rehearsal system which circulates information in the STM before entering the LTM. Information stored in the STM is represented as the output.

2.05.5 Measures of Retention.

Psychologists have devised number of ways to evaluate retention. Each is an attempt to retrieve and measure information held in storage.

Recognition: In recognition measures of retention, the subject is presented with the correct answer usually as one of a number of available answers. The subject then responds by selecting the answer that is thought to be correct. Objective scoring of such tests is possible because a result such as the number of correct answers, can be determined without the possibility of scorer bias (Wittig, 2001). In recognition, we are given a clue or shown the information from which we can remember something learned on a previous occasion. For example, matching or multiple choice questions are usually recognition tests of retention. Suppose you are asked the following question: Which is the Federal Capital territory in Nigeria?

a) Lagos
b) Port Harcourt
c) Abuja
d) Enugu

You should select C, recognizing that it is the correct answer and eliminate the others.

Recall: Recalldepends upon the active remembering of performances learned previously. It is the most difficult method of retrieving information. In recall measures of retention, a minimum cue statement or question is presented and the subject is required to supply additional information. Correct or incorrect responses are not presented before the subject responds. For example essay questions and "completion" question often are recall tests of retention. Suppose you are asked, "What are the names of all the footballers in the Super

Eagles of Nigeria?" No selection of names is furnished; you are expected to generate the answers without any additional prompting. Recall is the active reconstruction of information.

Relearning: In some situations subjects may have to relearn materials they have learned before. The amount of time or the number of trials required for relearning then may be compared to the amount of time or number of trials required for original learning. Measurement of retention can be computed in terms of the savings score shown in relearning. Normally we spend less time in relearning what we have learned before.

In all these three measures, zero should not be given in a recognition test, a recall test may be given zero and relearning however may show a negative score if the time or trials necessary for relearning exceed what was required for original learning.

Loss of retention and failure to retrieve what has been learnt means that the information has been forgotten. Kendra (2011) defines forgetting as typical failure in memory retrieval. It is the apparent loss of information already encoded and stored in the memory. This loss can be spontaneous or gradual in nature. According to online Education Blog (2008) "we are unable to retain or recall everything that we learn in life. Many of the experiences slip away with the passage of time.

2.06 Factors Affecting Information Processing

2.06.1 Motivation

Information processing is affected by the level of motivation of the person involved. If the person is motivated and the information to be processed is motivating, information processing is easier and its memory trace lasts longer in the individual. (Petty, Wegener &Fabrigar, 1997). People can engage in information processing because they have motivation and ability for the information to be processed. If there is need to formulate a highly accurate judgment then systematic processing has to be employed. When information is threatening,

subjects engage in more systematic processing than those that are not faced by a threatening message. Enhancing self-awareness in message recipients increases their thoughtful resistance to message that is personally important but not to a message that is not (Hutton &Bausmester, 1992). When the information to be processed is thought to be unimportant and insignificant, subjects employ a heuristic processing strategy. A practical perspective suggests that recipients employ a systematic strategy when reliability concerns outweigh economic concerns and heuristic strategy when economic concerns predominate.

2.06.2 Mood

Mood can play a significant role in how people perceive the world around them as well as the strategies used when processing incoming information. Mood affects the level of argument processing. (Petty, Fleming, Priester& Feinstein, 2001; Schwartz & Bless, 1991). Individuals in good moods tend to elaborate arguments extensively, are more persuaded by peripheral information and they do not differentiate between weak and strong messages compared to individuals in sad moods. People in sad mood tend to engage in more elaboration to react differently to strong and weak arguments, they respond to central rather than to peripheral appeals. People in positive mood prefer simple intuitive solutions to problems, rely on judgment heuristics, use broad rather than specific categories in classification tasks and make decisions both more quickly and on the basis of less information (Isen&Daubman, 1984). Positive mood appear to promote global, flexible, intuitive and holistic information processing. Negative mood is associated with more systematic, narrow focused and analytic forms of processing (Schwarz &Clore, 1996). Positive mood is shown to increase heuristic processing whereas negative mood increases systematic processing. According to cognitive approach, good moods limit processing capacity, reducing the availability for other processing tasks and resulting in the use of

heuristics. Mood may also function as a distraction, interfering with the ability to engage in careful elaborative processing (Petty & Brock, 1981).

2.06.3 Personality

In personality types, there are extroverts and introverts. It is usually said that extroverts are popular, outgoing talkative individuals and introverts on the other hand, are quiet, withdrawn and contemplative. These differences in communication skills and habit stem from a much deeper level, they both have different energy flow and thought processes. Some researchers even suggest that the brains of extroverts and introverts process information differently at the physical level. Extroverts make their decisions by looking at people, events and objects in the outside world while introverts rely on the ideas and thoughts coming from their inner world. Extroverts draw energy from the action itself. Introverts on the other hand loose energy while being active. They prefer to think then take a step and think again. Their thought processes is based on various concepts and ideas, extroverts direct their thoughts toward people and objects. Extroverts think "wide" and seek action, while introverts think "deep" and seek reflection. Personality types with strong sensing trait rely on information that is new, tangible and clear, they use their five senses to check. SENSING personality types do not trust intuition, they are always checking facts and details. Those with strong INTUITION trait trust the information that is more abstract or even theoretical. THINKING and FEELING traits highlight the different methods used by different personalities in decisions making, evaluation methods and information processing (Matthews, Deary and Whiteman, 2009). Individuals with a feeling trait tend to make their decisions only after they have immersed themselves in a particular situation, understood all nuances and perspectives, passed everything through inner filter and made sure the decision will achieve harmony whereas the thinking personality will try to approach the situation from a more

neutral position, trying to find a rational and logical decision that would not violate any existing rules or patterns.

2.06.4 Heredity and Environment

Heredity and environment are both factors that affect intelligence and information processing. Environment influences perception, and perception of one's environment is essential for survival, the human species has undoubtedly evolve some biologically built in perceptual mechanisms. Children are born into environment and the information they are first confronted with comes from direct stimulation from the environments they are in. the environment unavoidably has an effect on what a child perceives and what information is remembered and thought about. Environments vary and the factors instilled in children in relation to knowledge vary as well. As a child grows older the child's environment expands as does the child's base knowledge. Heredity is also a factor that can affect the development of information processing, it affects children's natural inclination of what information to remember, and this can also be caused by the environment. The child can be affected by the complex executive mechanism that involved with the information processing ability of the mind.

2.06.5 Processing Breakdown

Information registered through the senses is coded in the LTM via the STM. There could be problem in the processing of the material. The materials retained in the sensory storage system may not have been rehearsed enough to get to the STM. It is thus possible that the decay occurs before materials are taken to the STM and later to the LTM. Again the coding system may be faulty and weak so that wrong and inappropriate entries are made to the LTM. The coding system may be similar to or overlap with other coding system thus leading to interference. It is also possible that the painful nature of the material, retrieval mechanism is instructed to ignore the information.

2.06.6 Levels of Processing information

For a long time the multi-store model of memory was considered to be an adequate explanation of memory processes. However, the multi-store theory was criticized by Fergus Craik and Robert Lockhart (1972) and in its place Craik and Lockhart proposed the levels of processing theory. Although they accepted that the multi-store model accommodated the research findings reasonably well, they argued that there was also evidence to directly contradict it. The concept of rehearsal was criticized for being too general and unnecessary. The distinction between maintenance and elaborative rehearsal allowed Craik and his colleagues to argue that the number of rehearsals per se was less important in determining the transfer of information than the type of rehearsals engaged in by participants.

The poorest system for encoding information is to simply repeat the information, which is maintenance rehearsal. The best encoding system is to make associations, which is elaborative rehearsal. How much effort you put into encoding information is the basis for the levels of processing theory (Craik& Lockhart, 1972). The levels of processing theory says that remembering depends on how information is encoded. If you encode by paying attention only to basic features like length of phone number, information is encoded at a shallow level and results in poor recall. If you encode by making new associations, this information will be encoded at a deeper level, which results in better recall.

Unlike the multi store model, the level of processing approach does not require the assumption that information is transferred to LTM through rehearsal. Its approach is that the learning of anything requires a series of processing stages which vary along a continuum depth. This model suggests that the depth or level at which we process information determines its place in the LTM and also how well we recall that information. The levels of processing theory hypothesized that semantically processed memories are far easier to recall

than iconic because of the depth of processing, that is, the amount of thinking required is much greater in semantic coding than in iconic coding.

Craik and Lochart proposed in the levels of processing model that information could be encoded and processed at the shallow, deeper and deepest levels. The deeper the processing, the stronger the memory trace. The basic idea is that memory is determined by the degree or depth with which an information is analyzed. The model suggests that if you processed the information deeper, then the information would be much easier to recall, but information that is processed superficially would be more difficult to recall. Craik and Lockhart (1972), used semantic processing to represent deep processing which catalyzes the retaining of the information at the LTM. For shallow processing, we use the physical representation of the item for coding while for semantic processing, the meaning of the information is used for encoding it. For example, Craik and Lockhart (1972), performed a study in which they compared different techniques for coding memories. Research participants were shown words and then asked different questions about them but they were not asked to learn or memories the words. One group was asked questions which referred to the types of visual image that they had seen, such as ‘is it written in capital letters?’ The second group was asked questions which related to auditory coding, such as ‘Does it rhyme with house?; and the third group was asked questions which related to semantic coding, like would it fit into the sentence “she cooked the ____”?.

You can see from this that each of these three conditions involved different amounts of mental ‘work’ which the research participants had to do. With the visual questions, they simply had to describe what they were looking at but with the auditory questions they had to convert the visual information they were receiving into something like a sound image; and with the semantic condition they had to think about what the word actually meant.

When Craik and Lockhart asked the participants to recall the words, later on in the experiment, the researchers found dramatic differences. People in the visual condition recalled an average of 15 percent of the words; those in the auditory condition recalled about 35 percent, whereas those in the semantic condition remembered on average about 70 percent of the words that they had been shown.

From the results above, we can see clearly that this classic study shows how even a simple thing like asking people to imagine what a word sounds like increases someone's likelihood of remembering that word later. Craik and Lockhart explained it in terms of the amount of processing that the person has to undertake on the material. Information that you don't have to process much is easily forgotten but information processed at the deepest level is much easier to recall because it has to do with the meaning and this is very helpful to students who are preparing for examination. In a sense, according to the levels of processing theory, our memory is almost a by-product, what matters is the way we process the information in the first place.

The levels of processing is essentially concerned with the role of Coding in learning, the relationship between the manner in which material is processed and the probability that it will be subsequently remembered. It is a theory of long term memory with the coding taking place in the short term memory. (Baddeley, 1999). The levels of processing theory of memory tells us that if we process information we are receiving in some way, that is if we actually do something with it and change its form, then we are likely to remember it better. It also tells us that things are processed most deeply if we have to deal with their meaning rather than if we concentrate on how it looks on the page. So, the level you employ during encoding affects the way you process information.

2.07 Gender and Age Factors.

At the outset of an activity, students differ in learning as a function of their prior experiences, gender and age. The level of their later performance depends on the extent that parents and teachers encourage them to learn, facilitate their access to resources necessary for learning, and teach them strategies that enhance skill acquisition and refinement. Parent's academic aspirations for their children influence their children's academic achievements both directly and indirectly (Bandura, Barbaranelli, Caprara, and Pastorelli, 2001).Gender is one of the personal variables that have been related to differences found in motivational functioning and academic achievement. Different research has demonstrated the existence of different attribution patterns in boys and girls, such that while girls tend to give more emphasis to effort when explaining their performance (Lightbody, Siann, Stocks, & Walsh, 1996; Georgiou, 1999; Powers & Wagner, 1984), boys appeal more to ability and luck as causes of their academic achievement (Burgner&Hewstone, 1993). Different research has also pointed out that girls usually make external attributions for successes and failures, and that when they make internal attributions, these refer not so much to effort, but to ability. However, boys usually attribute successes to stable internal causes like effort, thus showing an attributional pattern which enables them to enhance their own image of themselves (Smith, Sinclair & Chapman, 2002).

Study on gender and age differences in cognitive processes, intellectual abilities, area of interest, stereotypical perceptions of every-day behaviour and the ability to perform various tasks has not been conducted. Two theories explaining personality differences between men and women have been proposed. The first suggests that the male is the prototypical human, and females should be understood in relation to men. The second opines that men represent the cognitive domain, which is positively valued in Euro-American culture, and women represent the less-valued affective realm (Hall & Lucas, 1976 in Klein,

2004). The differences in the scholastic achievements of boys and girls are generally attributed to biological causes and/or to cultural and stereotypes (Klein, 2004). It was concluded that males have better math and visuo-spatial skills (the kinds of skills an architect needs to design a building's angle and dimensions) than females, whereas females have better verbal attitudes than males. Subsequently, Maccoby (1987) concluded that the verbal differences between females and males had virtually disappeared, but that the math and visuo-spatial differences persisted.

Experts in the study of gender such as Hyde (1993, 2004; Hyde &Mezulis, 2001), believe that the cognitive differences between females and males have been exaggerated. For example, Hyde (2004) points out that there is considerable overlap in the distribution of females and males scores on math and visuo-spatial tasks. In a personal study by the U.S. Department of Education (2000), boys did slightly better than girls at mathematics and science. Overall, though, girls were far superior students, earning better grades and were significantly better than boys in reading. In another national study, females had higher reading achievement and better writing skills than male with the gap widening as students progressed through school.

Females are more likely than male to be assigned to special/remedial education classes – females are more likely to be engaged with academic materials, be attentive in class, put forth more academic effort, and participate more in class than boys (Dezolt and Hull, 2001). A probable reason for inequality in sex selection in some sex dominated subjects could be adduced to mere cultural and social orientation from parents and the entire society. However, the researcher is of the opinion that this idea can be readjusted for a better socio-economic society where all individuals are given equal opportunity to perform all tasks irrespective of their sex. Campbell, Hombo andMazzeo (1999), arguing along the same line, asserts that sex is not a good predictor of academic skills, interest or even emotional characteristics.

According to Campbell et al (1999), the difference between individual girls and boys are much greater than those between "average" boys. Arguing further, they posit that there is the tendency for people to generalize from the "average" girls or the average" boy to individuals. To them, averages can be very deceiving sometimes.

Cultural effects of a race and gender interaction for African American males among elementary school-aged children were stronger than socio-economic status in predicting reading achievement. Socio-economic status became stronger for individuals at the post-secondary level (Trusty, 2000) because more family and individual resources are necessary to attain this level. However, low prior mathematics achievement can have a strong barrier effect as well, regardless of family or individual socio-economic status.

2.08 How to Facilitate Retention of Learnt Materials.

In education, it is important to facilitate the retention of learnt material or there will be no change in behaviour. There are several ways in which this can be done.

i. **Ensure an anxiety free learning environment:** Threats of punishment and hostility should be avoided to ensure that learners have an anxiety free learning environment. Excessive levels of anxiety or fear affect learners' ability to concentrate, process and retrieve what they have learnt. To enable learners have an effective memory system, everything possible should be done to create a learning environment that is free of any anxiety generating stimuli.

ii. **Emphasize important points:** The important points of a lesson should be emphasized by the teacher through rehearsal and telling the learners that it is important that they remember them. This will help learners retain them better.

iii. **Encourage note-taking:** Learners should be encouraged to take down correct notes during classes as this will provide them with the opportunity to revisit what they have learnt. This will ensure better retention and recall later.

iv. **Motivate learners to learn:** Teachers need to motivate learners to learn by telling them the importance of everything they are taught in class and outside the class. When learners know the value of what they are learning in their lives, they will be intrinsically motivated to learn. Teachers should look for every possible method to motivate learners to learn as it will enable them retain better.

v. **Use familiar materials:** Learning materials and teaching aids used by teachers should be familiar to the learners and relevant to their day-to-day lives. This will ensure easy passage of learning through the memory and also facilitate retention. If learning materials are unfamiliar, difficult and above the cognitive level of learners, retention is inhibited.

vi. **Facilitate understanding:** Learners should be encouraged to get the meaning of concepts taught. Learners should seek to understand what they are taught rather than memorizing facts. Except for formulae, dates, rules and principles, memorization should be discouraged. Understanding the meaning of learnt materials will enhance retention and enable learners apply what they have learnt in new situations.

2.09 Review of Empirical Studies

The processes by which the human brain creates, stores, and uses memories are very complex and have been the topics of many research experiments in psychology. In 1972, Craik and Lockhart published a paper on levels of processing that suggested, "memory traces can be seen as records of analyses carried out for the purposes of perception and comprehension, and that deeper, more semantic, processing results in more durable traces" (Nyberg, 2002, p. 345). In the levels of processing model, there are three levels. The shallowest of these levels is the orthographic level, which is achieved by only visual cues. The middle level is the phonological level, which is achieved by auditory cues. Lastly, the

deepest level is the semantic level, which requires thought about the meaning of the cue. Brain imaging studies have found that semantic processing is associated with increased activity in the left prefrontal regions of the brain, contrasted with lower levels of processing. One such study, performed by Kapur, Craik, and colleagues, had FMRI scans measure the brain activity of participants making semantic decisions. After a retention interval, the participants took a memory test. When correct recognition accompanied high confidence, increased activity was seen in the left prefrontal regions (Nyberg, 2002, p. 347). By looking at the physiological aspects of memory, researchers are able to learn more about how memory operates, and why some forms of processing result in more vivid and easily retrievable memories.

One method of comparing the levels of processing against retention is studying the effects of these levels have on memory on students and then complete a memory task to see which levels yielded better results. Studies concerning the depth-of-processing (i.e., DOP) effects on memory show that levels of cognitive processing have predictable effects on performance in recall tasks. Several research studies have shown that tasks requiring semantic processing result in greater recall ability. Wagner and colleagues conducted a study with 12 right-handed, participants who engaged in semantic processing, non-semantic processing, and visual fixation tasks. Subsequent memory was much higher for semantic tasks (85% recognized) as opposed to non-semantic processing (47% recognized) (Wagner, et al., 1998). These results appear accurate, because semantic processing requires thinking about the whole task in a conceptual way. Whereas, the orthographic level of processing only allows visual elements to be internalized, and the phonological level of processing only allows the internalization of auditory elements. Of the three levels, semantic processing involves the most effort, as it requires the most analysis of information. Therefore, it is logical that semantic processing yields better memory results.

The premise that semantic processing yields better recall abilities is the focus of this experiment; executed bySwinkels(2003) of St. Edward's University in Austin, TX. In order to see the extent to which semantic processing improves recall capabilities, the experiment compared semantic processing with the other two levels of processing, phonological and orthographic. For this experiment, participants had to follow certain instructions that involved making judgments about words. These judgments created the different levels of processing. Counting the number of vowels in a word made the participants engage in orthographic processing, counting the number of syllables in a word made the participants engage in phonological processing, and deciding the pleasantness or unpleasantness of the word made the participants engage in semantic processing. It was predicted that the words the participants made semantic judgments about would be the most memorable to the participants. These results were expected because several studies have shown that semantic processing yields better recall results.

In another study, researchers measured memory through a two-phase experiment. In the study phase, the subjects were asked to respond yes or no to a number of questions that fell into three conditions: physical (whether the given word has four letters); rhyming (do two words rhyme); and semantic condition (does a given word fit into the sentence). Accuracy and response time were the dependent variables. Accuracy in the study phase was the lowest for semantics condition and highest for rhyming and physical conditions, although each condition had accuracy rates above 95%. In the test phase, the subjects were given 180 words, one at a time, and asked to response yes or no to whether they had seen the word in the previous phase. Also, there were 60 new foil words that the subjects had never seen. Accuracy and response time were the dependent variables. The test showed that words that required a deeper level of processing (those that were in the semantics condition), were easily recalled in the test phase than other words. However, the new words had the highest accuracy

rate. So, the levels of processing affect retention differently. The deepest level of retention leads to higher level of retention.

Craik and Tulving (1975) carried out ten experiments to test the levels of processing proposed by Craik and Lockhart (1972). The basic idea is that memory trace may be thought of as a rather automatic by-product of operations carried out by the cognitive system and the durability of the memory trace depends on the depth of processing, where depth refers to the greater degrees of semantic involvement. Subjects were, induced to process words at different depths by answering questions about the words. For example at the shallow level, questions were asked about the typescript, the deeper level was achieved by asking questions about rhyme and the deepest level was achieved by asking if the word would fit a particular category or sentence frame. After answering all the questions according to the three levels of processing, subjects were given a retention or recognition test on the words. In general, deeper encoding were associated with higher levels of performance on the subsequent memory test. It was further suggested that the depth of processing affects the durability of the memory trace. That is, stimuli that are analyzed at the shallow level lead to weak memory trace while those that are analyzed at the deepest level lead to longer lasting memory trace (Craik&Tulving, 1975).

In one of Craik and Tulving's (1975) experiments, the designed a complex but shallow task and after the task was carried out they found out that it yielded a lower of recognition than an easy deepest task. In their experiments, they found also that subjects had a higher retention level with positive responses than with negative responses. But when questions led to more elaborate encoding, both negative and positive responses were remembered by subjects. They found out that retention depends critically on the qualitative nature of the encoding operations performed, a minimal semantic processing yields better result than extensive structural analysis.

Another study was conducted by Craik and Watkins (1973). In that experiment, they asked subjects to remember only certain 'critical' words (those beginning with a particular letter) from lists presented either quickly or slowly. The position of the critical words relative to the others determined the amount of time the word spent in the short term memory and the number of potential rehearsals it could receive. The researchers found that retention over long periods was unrelated to either the amount of time a word spent in the STM or the number of implicit or explicit rehearsals. Craik and Watkins argued that in addition to maintenance rehearsal, in which material is rehearsed in rote fashion, that is, the form in which it was presented, another type of rehearsal exists. They called this elaborative rehearsal or elaboration of encoding. According to Craik and Lockhart (1972), it is a kind of rehearsal or processing that is important rather than the amount of rehearsal (Standen, 2011). The depth of processing theory has been developed to examine whether items are recalled in different ways depending on the analysis the item receives.

Al-sibai (2005) worked on effect of depth of processing on the retention of words. In this work, he replicated two of the experiments conducted by Craik and Tulving (1975), specifically the two experiments involved in "experiment 9: classroom demonstration" which involved using only three levels of encoding in a classroom context as opposed to the first eight experiment that involved rigid laboratory conditions. The three levels of encoding involved questions concerning type-script (uppercase or lowercase),rhyme questions and sentence questions in which subjects were either given a sentence frame with one word missing or were asked a category question. The participants were level five College of Languages and Translation female student majoring in translation.The first group was made up of 31 students they were told that the experiment was about perception and memory. The second group were 34 and they were also told that the experiment was about memory and perception but they were also told that they will be awarded marks for every word they are

able to remember and that the marks will be added to their final course grade. Al-sibai wanted to find out if motivation enhanced retention.

In the experiment, the participants were given sheets of paper containing YES/NO choices. On each trial, the participants were asked question orally and a word would appear on a computer screen. After that the participants would thick the correct answer on the YES/NO sheet. The questions were based on the three levels of processing. Half of the questions had YES responses while half had NO responses. Al-sibai used sixty words to form the questions and once the sixty questions were answered, the participants were given as retention test. For the retention test, participants were given a sheet of paper with 200 words. Sixty of the words are the ones that the participants have answered questions on. The remaining 160 words are distractors. Both groups were given ten minutes to select the words they saw on the screen, after which the papers were collected from them.

In Craik and Tulving's findings, words with YES responses were remembered more than words with NO responses. Al-sibai's finding was the direct opposite of this. Participants in both groups recognized best the rhyme words to which a NO response was given not for category or sentence frame words. Participants in Alsibai's experiment had better recognition for case words that in the original experiment. The findings of Al-sibai confirmed that deeply processed/encoded words are recognized better that shallow processed/encoded words. So deep processing of words leads to better retention of them. There was a boost for rhyme words probably because the rhyming pairs were striking.

Several researchers have also found that elaboration, that is, the amount of processing of a particular kind at a particular level is also important in determining whether materials is stored or not. For example, Craik and Tulving (1975) asked participants to decide if a particular word would be appropriate in simple sentences such as "She cooked the _____' or complex sentence such as 'The great bird swooped down and carried off the struggling

_____". When participants were later given a test of cued recall, in which the original sentences were again presented but without the particular words, recall was much better for the words compatible with the complex sentences. Since the same depth of processing (Semantic) occurred with both types of sentences, some additional factor (namely elaboration) must also be involved.

Kanegi (2009) conducted a study on levels of processing effects on word recall among psychology undergraduate students of the University of Texas at Austin. The effects of levels of processing on word recall were tested by measuring the number of words recalled after orthographic, phonological and semantic processing after they processed a set of words at the three levels. After this they were a distracter task which was then followed by a task of free recall of all the words they have processed. The mean scores of the words recalled showed that word recalled after phonological processing was significantly higher than words recalled after orthographic processing and words recalled after semantic processing was significantly higher than words recalled after phonological processing.Indicating clearly that deeper processing contributes to higher word recall.

Ferre (2003) of the University Roviraivirgili, Tarragona, Spain carried out another study on the effects of levels of processing on memory for affectively valenced words. The study tested whether subjects remember affectively valenced stimuli better than neutral stimuli when attention is not focused on the affective charge of the stimuli during encoding. Two encoding conditions, that is, orthographic and semantic processing were used to test memory of positive, negative and neutral words. The results of the study show that subjects remembered affectively valenced stimuli better than neutral stimuli when they encode them according to their emotional content as well as to other features of the stimuli. Positive and negative words were better remembered than neutral words when semantically encoded and neutral words were remembered better than positive and negative words when processed

orthographically. The results of this study suggest that the affective charge of a stimulus can affect retention even when a subject's attention has not been focused on it during encoding.

Doe J. (2008), conducted another study on benefits in recall for deeply processed items, twenty seven undergraduate students (16 female and 11 male) from an introductory psychology class at North Dakota State University participated in this study. The ages of the participants ranged from 18 – 23 years. The participants viewed a series of 60 words and were required to answer a question with each word. The questions were designed for participants to make shallow or deep level judgment for the words. Participants were later given a recognition test of the words they viewed earlier. When participants were required to make judgment at the deeper level, recall was high compared to words that required shallow level of judgment. Making a deep level of judgment allowed for deeper processing which leads to greater recall.

Anderson J., Kehoe J., Robb K. and Robb W. (2006) conducted a study on effects of levels of processing on remembering and knowing. They used 5 male and 4 female undergraduates of the University of St. Andrews. Subjects were assigned to each experimental condition such that one male and one female completed each of the four conditions. The stimuli consisted of 240 medium frequency words, ranging in length from 4-9 letters. These words were used to create four conditions, A, B, C and D. each condition contained 78 words in total, 60 words which were presented at study and a further 18 words stems which were presented at the test with the stems of the words from the condition in which the subjects did not take part at study.

Each subject completed two conditions, either A & B, or C & D. each condition consisted of a study and a test phase. At study, subjects had 60 words appear on a screen in front of them. Prior to each word, a cue appeared on the screen. A circle indicated that the subjects were to state whether the words meaning was pleasant or unpleasant (deep

condition). A cross indicated that the subject was to state whether the vowels were in alphabetical order or not (Shallow condition). Subjects had as much time as they needed to do this for each word before the next word appeared. A test, a cued recall paradigm was used. Subjects were presented with 78 word stems, with words stems being the first three letters of English words. Sixty of these stems belonged to words they had just studied, 18 were words from the conditions subjects did not take part in. the task of the subjects was to complete the stems with the words they have studied.

To test subjects recollection of whether these words appeared at study, when subjects completed the word stem they were asked to say remember, know or new. Remember responses were to indicate that subjects remembered the specific episode and details of the episode in which the word occurred, know responses were to indicate that the subjects knew that the word occurred at the study but could not remember any details of the episode. New was to indicate that the subject believed the word they had given did not appear at study. Subjects had three seconds to give their answer before starting a new trial. The result indicate that words that were semantically processed were better remembered thereby providing higher recall and it also generated more remember words. The results of the experiment were observed in the condition of cued recall. It can be seen that for accurate recall processing information semantically is more effective than attempting to consciously tore information on a shallow level.

McKelvie and Pullara (1988) studied the levels of processing theory on hypnotized participants. They hypothesized the hypnosis will increase memory on information that was deeply processed rather than information that was shallowly processed. Participants were given a learning period in which they viewed a series of 60 pictures of common items. They were asked to make a rating on the visual complexity (shallow processing) on half of the pictures and on the other half make a rating on how pleasant each picture was (deep

processing). They were given three testing periods to recall any picture they remembered. The first test was given immediately after they viewed the 60 pictures. The second test was given two days later after the participants were split into three groups (hypnosis, simulation and control). The hypnosis group was given suggestions under hypnosis that their memory would increase. The simulation group was told to pretend that that they were hypnotized and given the same instruction as the hypnosis group. The control group was told to complete a drawing task prior to the test. The third test was similar to the second, but the hypnosis and simulation groups had further suggestions their memory would increase. A final recognition test was given where the participants from each group viewed a series of 90 pictures with 30 new pictures added to the 60 old pictures. The participants were asked to judge if the pictures were old or new. The results indicated that those under hypnosis did not perform any better than those in the shallow processing group. But however, the hypnosis group recalled more deeply processed items than the simulated and the control groups. The effect of depth was strong for hypnosis group, weak for simulated group and absent for control group.

Craik (2002) proposed that cognitive neuroscience should be looking for maps of neural activity for recollective experience. Recent evidence that supports the level of processing theory has been done using brain-imaging (Nyberg, 2002). Nyberg reviewed literature that used PET and fMRI to examine brain activity during encoding and retrieval. He mentioned that some of the brain regions that are activated at encoding are also activated during retrieval. There is evidence that there is more brain activity associated with semantic processing than there is with shallow processing in the frontal and temporal regions of the brain. This increased activity in the frontal and temporal regions leads to better recall. Nyberg concluded that brain-imaging has identified brain correlates of the concepts from the levels of processing theory.

The various empirical studies conducted on the levels of processing confirmed the fact that semantic processing leads to greater recall. But the studies also expanded on the tenets of the levels of processing.

2.2 Summary

Literature has been reviewed on levels of processing and retention. Other areas of memory like models of memory, the three levels of processing versus retention and how to facilitate retention of learned materials have also been reviewed. The levels of processing of Craik and Lockhart says that processing in the human memory happens along a continuum depth from shallow to deeper levels of processing. It holds that the more you analyze a stimulus, the more it will be retained and the easier it will be to recall. This notion of memory came as a rejection of the multi store model of Atkinson and Shiffrin which held that information is moved to the long term memory through rehearsal. It categorized memory in to discrete stores that hold different kinds of information. Craik and Lockhart had their own reservations about the multi store model, they came up with a process oriented memory which holds that information is processed at the shallow, deeper and deepest levels. The level of retention shows how 'deeply' information has been processed. In the working memory model, Baddeley and Hitch say that there is a difference between immediate memory and the long term memory and they call the immediate memory working memory which helps us to solve particular problems or perform certain tasks. It has its various components.

Retention is simply the storage of what has been processed. Storage is of three types – sensory storage, short term storage and long term storage. It is through these that information is encoded, stored and retrieved for usage. Three measures of retention have been identified – recall, recognition and re-learning. Recall is the active reconstruction of what has been learnt. Recognition is a measure that gives options as answers to a question while re-learning gives

opportunity to re-learn what has been learnt before and normally, it takes lesser time to re-learn.

In information processing, certain factors play certain roles. For example if there is motivation or no motivation on a certain topic, or if one is in a positive or negative mood, it affects the way the person processes information. Personality, hereditary properties and the kind of environment a person grows up in or lives in, influence in different ways, information processing. Some learning theories related to information processing have been included in the review of related literature. These are the meaningful learning theories of Ausubel, the network theory of McClelland and the schema theory of Anderson. This study based on the ideas of the schema theory. A schema is information – concepts, knowledge, information about prior events that already exists in a person's mind. So schemata are prior knowledge linkages that influence the amount of proficiency of our learning. When a new thing is learnt, it fits in to previously acquired general knowledge about that thing. Schemata are always organized meaningfully and they change moment by moment if new information is acquired.

The levels of memory processing is a theory of the LTM where learning is encoded according to meaning. The contents of the LTM includes procedural, episodic and semantic memories. Semantic memory represents a person's general knowledge of the world. New information being processed is added to existing schemata and sometimes the schemata are re-organized to accommodate entirely new information. If information is encoded according to its meaning, it becomes embedded in to appropriate schemata and thus easy to retrieve whenever the need arises. When learners learn without understanding the meaning, it is not well embedded in the appropriate schemata. Its memory impression remains superficial and therefore recall is difficult. A number of ways have suggested on how to facilitate retention of learnt materials. This is followed by the review of a number of empirical studies. Most of the studies showed that semantic processing leads to better retention and recall.

This research work differs from previous studies that have been reviewed in that its subjects were senior secondary school students whereas most previous studies used University students. It went beyond just finding out the difference between one processing level and another to investigating the effect of each level of processing information on retention and retrieval of what learners learn. It included a control group which did not process at any of the three levels of processing information, it paired the levels of processing information with other variables like gender, subject of study and ability level and it had at its background a speculation that lack of proper processing of learnt materials might be one of the factors contributing to mass failures in public examinations in the country.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter the methods and procedures followed in carrying out this study are described. This involves describing the type of research design that was used, the sample and sampling techniques and a detailed description of the research instrument and the procedure for data collection.

3.2 Research Design

In this study, a quasi-experimental design was used. The experimenter chose simulated before-after design, it is also called separate sample pre-test/post-test design (Olayiwola, 2007). The design is made up of an experimental group and a control group, the control and treatment groups are randomly selected from the population. The control group is pre-tested while the treatment group was given treatment and then post-tested. The pre-test scores of the control group is then compared with the post-test scores of the treatment group i.e. $O_2 - O_1$. If a significant difference is obtained, it is assumed that the difference is as a result of the treatment condition. The researcher chose this design because if the same group is pre-tested and post-tested, there is a possibility that the pre-test might sensitize the subjects on the items on the test thereby affecting their performance in the post-test. Having a different group for the pre-test completely eliminates the possibility of the pre-test sensitizing the subject before the treatment and post-test.

The diagram for simulated before-after is shown below:

	Pre-test	Treatment	Post-test
Treatment group		x	O_2
Controlgroup	O_1		

3.3 Population of the Study.

The target population of this study includes the senior secondary school students in Jalingo Local Government area of Taraba state. There are seventeen State Senior Secondary Schools in Jalingo Local Government Area and their population for the 2012/2013 academic session is given in the table below:

Name of School	Population of Senior students
G.D.S.S. Kona	249
G.D.S.S.S. Nukkai	250
G.D.S.S.S. Howai Mile six	307
G.D.S.S.S. SalihuDogo	400
G.D.S.S.S. Magami	255
G.D.S.S.S. Mafindi	88
G.D.S.S.S. Mohammed Nya	215
G.D.S.S.S. WuroSambe	192
G.D.S.S.S. Sabongari	400
Govt. Comprehensive Senior	450
G.D.S.S.S. Central	250
G.D.S.S.S. Hassan	451
G.D.S.S.S. Model	240
G.S.S.S.S.S. Jalingo	1199
Govt. College Senior Jalingo	506
S.A.I.SJalingo (senior)	220
Govt. Senior Technical	658
Total	6,390

3.4 Sample and Sampling Technique

Five schools were randomly selected - Nukkai, Central, Hassan, Kona and Howai Government Day Senior Secondary Schools inJalingo L.G.A. They were selected because they are mixed school with both science and Arts students. The researcher chose 200 subjects from the SS 2 classes of each school, 40 subjects were selected from each school through simple random sampling. The researcher chose 200 subjects from different schools because being a quasi-experimental study not too many subjects are required, the 200 subjects are enough for the study.

3.5 Instrumentation

The research instrumentation includes the following:

i. Pre-processing of learning material instrument.

ii. The processing inducer (treatment instrument).

iii. Post-processing of learning materials instrument.

3.5.1 Pre-processing of learning material instrument

This is instrument is more of an experimental process made up of a list of twenty words. It was given to the control group as a pre-test. The subjects in the control group studied these words for four and half minutes and immediately they were given a post-test requiring them to identify all the words they have learned in the pre-processing of learning materials instrument. Each item was marked out of five marks, making a total of one hundred for twenty items. To view the list of words for the pre-test, check appendix i.

3.5.2 The processing inducer (Treatment instrument)

The treatment instrument is a language test, it contains sixty questions that have been formulated using sixty chosen words. The questions require YES/NO answers. The questions are of three types based on the three levels of memory processing of Craik and Lockhart's theory. The format of the questions has been adapted to the format of the questions Craik and Tulving (1975) used in their ten experiments on the levels of processing theory.

There are twenty questions on each of the levels of processing. Participants were induced to process the words to different depths by answering all the questions provided. Half of the questions at each level require YES answers while the remaining half requires NO answers.To view the sixty questions, check appendix ii.

This instrument has been developed for the sole purpose of inducing subjects to process the items on the instruments at the three levels of processing.

3.5.3 Post-processing of learning materials Instrument (post-test instrument).

This list contains the sixty words that subjects processed when they answered the sixty questions in the treatment instrument and they include the twenty words that the control group studied. The remaining ninety words are distracters. Subjects were given this list after treatment and they were asked to tick or choose all the words they answered questions on. After the test, subjects' responses enabled the researcher find out the difference in retention between among the three levels and between the experimental and control groups.Each item on the test was marked out of five marks, making the total score of each level to be one hundred. To view this list, check appendix iii.

3.6 Pilot Testing

A pilot test was conducted on the main instrument of the study, that is, the language test instrument (the processing inducer), that was developed to induce the subjects to process chosen words at the various levels of processing. The researcher used split half method of reliability where the items on the instrument are divided into odd and even numbers or first half and second half. The scores of the odd and even numbers are then correlated. Fifty subjects were selected from the Government Science Secondary School Jalingo. The subjects consisted of male and female, from the senior classes of the school. The subjects were given the language test which was followed immediately by a post test. The scores of the post-test

were computed and analyzed. The essence of the pilot study was to establish the reliability of the instrument.

3.7 Validityandreliabilityofresearchinstrument.

After constructing the language test instrument, the researcher made sure its content tallies with the objective of the study. In order to ensure that the instrument measures what it is supposed to measure, the instrument was constructed using the English Language syllabus of the senior secondary school. The instrument was also given to English teachers and lecturers in educational psychology requiring their comments and suggestions to ensure the content validity. It was also given to an expert in measurement and evaluation.

The reliability index of the instrument was established by analyzing the data collected from the pilot study using Cronbach's alpha. The reliability of the instrument stands at .794. Thus this instrument can be said to be reliable since it falls within the reliability benchmark of 0.5 to 0.999 set by Anastasi (1950) and also affirmed by Kerlinger (as cited in Kolo, 2003).

3.8 Procedure for Data Collection

The first step that was taken in the collection of data was to get a letter of introduction from the department after which the researcher proceeded to the various schools that were randomly selected for the study. After proper introduction and acceptance by the schools, arrangements were made for the days of data collection in different schools. The procedure followed in each school is explained below:

Phase one: Pre-test

The main data for this study was collected in different days. In each school, it started with a pre-test where the control group was given the pre-processing of learning materials instrument to study for four and half minutes after which they proceeded immediately to do the post-test. This instrument consists of list of words which the subjects studied with in a

stipulated time limit. The result of the pre-test was compared with the result of the experimental group.

Phase two: Treatment (processing)/Post-test

Thetreatmentgroups were given the processing inducer (treatment instrument) which is a language instrument containing sixty questions with twenty belonging to each level of processing. For example, to process a word at the orthographic/shallow level, a group of subjects was asked questions like: "Is the word 'HOUSE' in capital letter?" "Is the word 'shoe' in capital letters?" For the deeper/phonemic level, another group of subjects was asked questions like: "Does the word 'moon' rhyme with 'soon'?" "Does the word 'bag' rhyme with 'pot'?" And for the deepest/semantic level a different group of subjects was asked questions like: "Is the word 'apple' a type of fruit?" "Would the word 'cooked' fit the following sentence: Before I went out, I _____ my mother's clothes.There were fifty subjects in each experimental group. Fifty subjects processed the twenty questions in each level. As subjects read each question and tick the answer, they were being induced to process each word in one of the three levels of memory processing. When all the questions were answered, subjects proceeded with the post-test immediately.

The post-test is a recognition test, a recognition test with YES/NO answers is used because of its ability to elicit stored memory. The choices made provided the needed data for this study. This list of words is meant to test retention in the subjects. The words the subjects are expected to identify in the recognition test are according to the three different levels of processing.The length of the time used in processing and post-test varied according to each level.

3.9 Procedure for Data Analysis

The data collected in this study was analyzed through the use of descriptive and inferential statistics. All the hypotheses were tested at 0.05 alpha level of significance

using different statistical tools.Univariate analysis of variance was used to analyze hypothesis one and four while independent sample t-test was used to analyze hypothesis two & three.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction.

This chapter presents the data analysis of the study titled "Effects of levels of processing on retention of learnt materials among senior secondary school students of Jalingo local government area of Taraba state". The analysis is based on 200 students from Arts and Science based courses. The SPSS Statistical Package was used for the data analysis. The first section presents the demographic characteristics of respondents by means of frequencies and percentages, while the second section tests four hypotheses and answers the research questions using different statistical tools. The third section outlines the major findings of the study and the last section discusses the findings. The results of the analysis are presented below;

4.2: Demographic Characteristics of Respondents

Table 4.2.1 frequency and percentages demographic characteristics of respondents.

Variable	Description	Frequency	Percent	Cumulative Percent
School	GDSSS Kona	40	20.0	20.0
	GDSSS Howai	40	20.0	40.0
	GDSSS Central	40	20.0	60.0
	GDSSS Hassan	40	20.0	80.0
	GDSS Nukkai	40	20.0	100.0
	Total	200	100.0	
Gender	Male	73	48.7	48.7
	Female	77	51.3	100.0
	Total	150	100.0	
Subject	Art	74	49.3	49.3
	Science	76	50.7	100.0
	Total	150	100.0	
Groups	Experimental group	150	75.0	75.0
	Control group	50	25.0	100.0
	Total	200	100.0	

According to the table above, 200 students were drawn from five schools, that is, 40 students from each school. 73 of the students representing 48.7% were males while 77 of the students representing 51.3% were females. The students were drawn from Arts and science based courses. 74 of the students representing 49.3% were science students while the remaining 76 students representing 50.7% were Arts students. A total of 150 students were selected for the experimental group (50 for each level) while 50 students were selected for the control group.

4.3 Answers to research questions

RQ1: Is there difference in retention of learnt materials among the three levels of processing information?

Table 4.3.1 Mean difference in retention of learnt materials among the three levels of processing information and the control group.

Processinglevels	Mean	Std. Deviation	N
Shallow processing	62.9000	19.64195	50
Deeper processing	71.5000	17.64878	50
Deepest processing	79.4000	15.40739	50
Control	61.4000	24.05436	50
Total	68.8000	20.62004	200

The above table shows the mean effect of retention levels of the three levels of processing and it also shows the mean retention of the experimental and control groups. Compared to students who processed learnt materials at the shallow level (*M*=62.90, *SD*=19.64) and deeper level (*M*=71.50, *SD*=17.64), students who processed at the deepest level (*M*=79.40, *SD*=15.40) had a better memory retention which is also above the omnibus mean memory retention of all the groups put together. The control group has a mean (*M*=61.40, *SD*=24.05) which is lower than all the three experimental levels of processing.

RQ2: How do the male students compare to the female students in retention of learnt materials?

Table 4.3.2Mean difference in retention between males and females in the experimental group.

Variable	Gender	N	Mean	Std. Dev.
Retention Scores	Male	73	70.890	20.367
	Female	77	71.623	17.290

Table 4.3.2 above reveals that there isa difference in the mean retention of learnt materials between male (*M*=70.89, *SD*= 20.367) and female (*M*=71.62, *SD*=17.29) participants in the experimental group. It shows that female participants perform marginally better than the male participants in retention of learnt materials with a mean advantage of .733.

RQ3: How do the Arts students compare with the Science students in retention of learnt materials?

Table 4.3.3Mean difference in retention of learnt materials between Art and Science students

Variable	Subject	N	Mean	Std. Dev.
Retention Scores	Arts	74	67.094	19.602
	Science	76	75.328	17.133

Table 4.3.3above reveals that there is a difference in the mean retention of learnt materials between Arts (*M*=67.09, *SD*=19.60) and science students (*M*=75.32, *SD*=17.13). The Science studentshave higher retention level than the Art students with a mean advantage of 8.234.

This means that the science students were better than art students in retention of learnt materials.

RQ4: How do high ability students compare with average and low ability students in retention of learnt materials?

Table 4.3.4 Mean difference in retention of learnt materials among high ability, average ability and low ability students.

Retention ability	Mean	Std. Deviation	N
High ability students	78.7712	12.10595	118
Low ability students	31.2500	9.79912	12
Average students	51.0000	4.16754	20
Total	71.2667	18.79050	150

Table 4.3.4above shows the mean retention levels of learnt materials of students who have high ability, average ability and low ability. The high ability groups are those who scored from 60 and above, the average group are those who scored between 40-60 and the low ability groups are those who scored from 40 and below. Compared to students of low ability (*M*=31.25, *SD*=9.79) and average ability students (*M*=51.00, *SD*=4.16), students with high ability (*M*=78.77, *SD*=12.10) had a better memory retention of learnt materials which is also above the omnibus mean memory retention of all three groups put together.

4.4 Hypotheses testing

4.4.1 Hypothesis one states that there is no significant difference in retention of learnt materials among the three levels of processing information.

Table 4.4.1: Univariate Analysis of variance testof significant difference among three levels of processing of learnt materials.

Source	Type III SS	df	MS	F	Sig.	Eta^2
Corrected Model	10461.000[a]	3	3487.000	9.217	.000	.124
Intercept	946688.000	1	946688.000	2502.338	.000	.927
Processinglevels	10461.000	3	3487.000	9.217	.000	.124
Error	74151.000	196	378.321			
Total	1031300.000	200				
Corrected Total	84612.000	199				

a. R Squared = .124 (Adjusted R Squared = .110), Sum of Square = SS, Mean Square = MS

The Univariate ANOVA table above shows that the levels of processing have significant effect on retention. $F(3,196)=9.217$, $p<.001$. It means that statistically, memory retention level significantly differ across the three levels of processing and the control group and the four variables together were found to account for 12.4% of variance in memory retention. Based on this result, it is safe to reject the null hypothesis which states that there is no significant differencein retention of learnt materials among the three levels of processing. A follow up Post Hoc test was carried out to test for multiple comparison of mean across the three levels and the table is shown below.

Table 4.4.2: LSD Post Hoc test of mean comparison in memory retention among three levels of processing and control group

(I) Processing levels	(J) Processing levels	Mean Difference (I-J)	Std.Error	Sig.
Shallow processing	Deeper processing	-8.6000*	3.89010	.028
	Deepest processing	-16.5000*	3.89010	.000
	Control	1.5000	3.89010	.700
Deeper processing	Shallow processing	8.6000*	3.89010	.028
	Deepest processing	-7.9000*	3.89010	.044
	Control	10.1000*	3.89010	.010
Deepest processing	Shallow processing	16.5000*	3.89010	.000
	Deeper processing	7.9000*	3.89010	.044
	Control	18.0000*	3.89010	.000
Control	Shallow processing	-1.5000	3.89010	.700
	Deeper processing	-10.1000*	3.89010	.010
	Deepest processing	-18.0000*	3.89010	.000

**.= mean difference is significant at the .05 level*

The above least significant difference multiple comparison of mean shows that processing learnt materials at the deepest level significantly improves memory retention than shallow processing, $p<.001$ and deeper processing, $p<.05$. Processing learnt materials at the deeper level was also found to be better in retention than shallow processing, $p<.05$. However significant mean difference in retention of learnt material was not found between shallow processing and the control group, $p = 7.00$. This result shows that retention of learnt materials is largely depending on the depth of processing the material.

4.4.2 Hypothesis two states that there is no significant difference in retention of learnt material between male and female students.

Table 4.4.3. Independent sample t-test of difference in retention between males and females.

Variable	Gender	N	Mean	Std. Dev.	df	$t_{calculated}$	P	Decision
Retention	Male	73	70.890	20.367	148	.238	.812	Retained
Scores	Female	77	71.623	17.290				

Table 4.4.3. above reveals that there is no significant difference in the mean retention of learnt materials between males and females $t(148) = .238$, $p = .812$. Due to this statistical evidence, it is safe therefore to retain the null hypothesis which states that there is no significant difference in retention of learnt materials between male and female students.

4.4.3. Hypothesis three states that there is no significant difference in retention of learnt material between Art and Science students.

Table 4.4.4 Independent sample t-test of difference in retention between Art and Science students.

Variable	Subject	N	Mean	Std. Dev.	Df	$t_{calculated}$	P	Decision
Retention	Arts	74	67.094	19.602	148	2.741	.007	Rejected
Scores	Science	76	75.328	17.133				

Table 4.4.4 above reveals that there is significant difference in the mean retention of learnt materials between Science and Art students $t(148) = 2.741$, $p = .007$. The Science students (M=75.328) have higher retention level than the Art students. (M=67.094). Given this statistical evidence, the null hypothesis which states that there is no significant difference in retention between Arts and Science students is therefore rejected.

4.4.4 Hypothesis four states that there is no significant difference in retention of learnt material among high, average and low ability students.

Table 4.4.5 Univariate Analysis of variance testof significant difference among three ability levels of students.

Source	Type III SS	df	MS	F	Sig.	Eta^2
Corrected Model	34076.261[a]	2	17038.131	135.142	.000	.648
Intercept	182837.633	1	182837.633	1450.225	.000	.908
Ability levels	34076.261	2	17038.131	135.142	.000	.648
Error	18533.072	147	126.075			
Total	814450.000	150				
Corrected Total	52609.333	149				

a. R Squared = .648 (Adjusted R Squared = .643), Sum of Square = SS, Mean Square = MS

The Univariate ANOVA table above shows that there is a statistically significant difference in retention of learnt materials among the three ability levels, $F(2,147) = 135.142$, $p<.001$. The three levels together were found to account for 64.8% of variance in memory retention. Based on the above statistical evidence, the null hypothesis which states that there is no significant differencein retention of learnt materials among high ability, average and low ability students is therefore rejected. A follow up Post Hoc test was carried to test for multiple comparison of mean across the three ability levels and the table is shown below.

Table 4.4.6 LSD Post Hoc test of mean comparison in memory retention among three ability groups.

(I) Retention ability	(J) Retention ability	Mean Difference (I-J)	Std. Error	Sig.
High ability students	Low ability students	47.52119*	3.40216	.000
	Average students	27.77119*	2.71518	.000
Low ability students	High ability students	-47.52119*	3.40216	.000
	Average students	-19.75000*	4.10001	.000
Average students	High ability students	-27.77119*	2.71518	.000
	Low ability students	19.75000*	4.10001	.000

**.= mean difference is significant at the .05 level*

The above least significant difference multiple comparison of mean shows that retention of learnt materialsamong high ability students were significantly betterthan average students, $p<.001$ and low ability students, $p<.001$. Retention of learnt materials among average students was also found to be better than that of the low ability students, $p<.05$.

4.5 Summary of findings

The following are the major findings of the study:

1. There is significant difference in retention among the three levels of processing information. (F=9.217, P=.001).The trend here is that the deeper the processing, the higher the retention.
2. There is significant difference between the experimental group and the control group – shallow level- 62.9000, deeper level- 71.5000, deepest level- 79.4000 and the control group- 61.8000.
3. Male and female students retain learnt materials in more or less the same manner because there is no significant difference in the mean retention level of both groups. (t=.238, P=.812).
4. Science students scored higher and differed significantly in retention from the Arts students which indicates that they vary in their approach to learning. (t=2.741, P=.007).
5. Significant difference exists among three ability levels. (F=135.142, P=<.001). The trend here is that the higher the level of ability, the higher the level of retention.

4.6 Discussion

A number of interesting findings have been discovered in this study. The findings support some researches made in some parts of the world. The results from testing all the hypotheses in this study are discussed below:

Levels of processing and retention

The levels of processing holds that memory is simply a product of depth of processing, that the depth at which you process information will determine the level of its retention. The findings of this study support this main claim of the levels of processing theory. The results of analysis of data collected reveal that levels of processing have a

significant effect on retention of learnt materials. This is clearly seen in the fact that the mean scores of the experimental group is significantly higher than the mean score of the control group. It can then be said that the difference in the performance between the experimental and the control group is as a result of the processing (treatment) that the experimental group were exposed to. This means that all the three levels influence retention but the deepest level has the highest retention level. It shows that there is significant effect between depth of processing and greater retention of learnt materials. All the mean scores of the three levels are higher than the mean score of the control group but there is no significant difference between the performance of the control group and the shallow level. This result is supported by many previous studies carried out on the levels of processing. For example, the works ofCraik and Lockhart (1972),Craik and Tulving (1975), Kanegi (2009), andGargano (1992). The results of their experiments show clearly that the levels of processing have varying degrees of effect on retention of learnt materials. Their results are given as follows Craik and Lockhart (1972) – shallow level – 15%, deeper level – 30%, deepest level – 70%. Craik and Tulvin (1975) – shallow level – 20%, deeper level – 50%, deepest level – 80%. Gargano (1998) – shallow level – 3.6, deeper level – 7.5, deepest level – 9.5 and Kanegi (2009) – shallow level – 1.48, deeper level – 2.76 and deepest level – 5.58.

All the results above support the major claim of the levels of processing theory which says that processing according to the meaning of a given stimulus leads to longer lasting memory trace. For example the question “Is the word ‘rooster’ a type wild animal?” is at the deepest/semantic level and it requires subjects to process the word rooster using semantic connections and existing cognitive structures. The deepest level contributes to higher retention of learnt materials because semantic processing involves most effort and requires more analysis of information. Semantic memory includes knowledge of word meanings in connection with one’s general understanding of the world and concept representation of

schemas and scripts. Researchers believe that memory consists of links between related concepts. Previous research dealing with the notion that knowledge is organized in terms of connections between related concepts has been reinforced by findings dealing with semantic memory by Collins and Quillian, (1969): McCloskey and Gluckberg, (1978), Meyer and Schvaneveldt (1971), (as cited in Nelson, Bennet, Gee, Schreiber & McKinney, 1993). A stimulus will have a higher recall value if it is highly compatible with preexisting semantic structures. Craik (1972). According to the semantic network theories, this is because such a stimulus will have many connections to other encoded memories, which are activated based on closeness in semantic network structure. This activation increases cognitive analysis, increasing the strength of the memory representation. It is therefore logical that semantic processing yields greater retention result.

The question "Does the word stove rhyme with glove?" is at the deeper/phonological level and requires subjects to think about the sound of the word. The question "Is the word transmit printed in capital letters is at the shallow/orthographic level and requires subjects to look at the physical appearance of the word. The phonological level contributes to higher retention of learnt materials than the orthographic level. The degree of the influence/impact of each level on retention is discussed below.

According to the levels of processing theory, shallow level of processing is the weakest of all the three levels in term of level of retention. The result of this study revealed that retention is lowest at the shallow level. But its mean score of 62.9000 shows that even at the shallow level, levels of processing can have a significant effect on retention. The result has agreed with the findings of the study carried out by Craik and Lockhart in 1972. Craik and Lockhart carried out a study in which they compared different techniques for coding memories. Research participants were shown words and then asked different questions about them. Each of the three groups in the study was asked questions at one of the three levels of

processing. When they were asked after to recall the words, there were dramatic differences. Those in the shallow level remembered an average of 15%. This finding is also supported by the work of Craik and Tulving (1975). The conducted ten experiments on the levels of processing framework. In the second experiment; participants recalled 20 percent of the questions asked at the shallow level. These data again are interpreted as showing thatshallow processing takes the shortest among all the three levels.

However, I think the time to encode is not the critical factor. It took just seconds to answer questions at the shallow level but the mean score is above average and some students remembered more words at the shallow levels than the deeper level. Even though the mean score of the retention level at the shallow level is the lowest, thereby agreeing with past studies, the level of retention is higher than for example the scores of participants in Craik& Lockhart and Craik&Tulvin's studies. This might be probably because of the distinctiveness of some of the items on the processing done by the subjects which enabled them not only to encode just the physical features of the items but other attributes as well. This could be one of the reasons why the retention level here is higher than the scores of some previous studies. This view is supported by the findings from numerous experiments conducted by Branford, Frank, Morris,& Stein, (1979); Eysenck (1979) and Nelson (1979), where the results indicated clearly that a memory trace records multiple levels of information. This led to the development of a general formulation that subjects will automatically encode most attributes of stimulus materials regardless of the orienting task. For example, when a subject is asked whether the word 'hostile' is in capital letters, the meaning is also brought to the mind of the subject except if the word is completely new. Some other factors like intelligence, attention, socio-economic status, sharp focus and interest might have played a role.

At the deeper level of processing, the mean score shows that it has a significant effect on retention and it significantly differs from the shallow level. This result agrees with some

of the findings of many research works in the past though slightly higher than others. The higher score could be because of some of the reasons discussed under shallow level and it could have been because of the striking rhyme between some of the words like ‘dew-view’, ‘hoe-toe’, ‘stove-glove’.

At the deepest level, the participants had the highest retention level of a mean score of 79.4000 which also agrees with very many past research works on levels of processing. The key factor that has led to such a high level of retention according to Craik and Lockhart is because learners were induced to process the learning material according to their meaning and by making associations. But it is also possible that the nature of elaboration and distinctiveness of some of the information processed contributed to better retention which is another way of conceptualizing depth. The results of some brain imaging studies carried out in some researches show that semantic processing is associated with increased activity on the left prefrontal region of the brain contrasted with lower levels of processing.

When it comes to retention, the shallow and deepest levels are far apart. Their effect on retention varies greatly. The analysis of data collected showed that significant difference exists in retention of learnt materials by the students between shallow and deepest levels. This occurs because the mental system is primarily concerned with the meaning of a stimulus, so it is more beneficial to store information that has undergone deep processing than information that has undergone shallow processing. Semantic processing is more relevant to existing cognitive structures and beneficial to the organism.The high level of retention obtained at the deepest level in this study also supports the findings of Branford and his colleagues (1979) where they suggested that it may be the non-distinctiveness of shallow encodings that leads to poor retention. Eysenck (1993) has argued that it is often difficult to choose between level of processing, elaboration and distinctiveness because they can occur together. It is obvious that retention cannot be predicted solely on the basis of level of

processing because more elaborate or distinctive semantic encodings are usually better remembered than non –elaborate or non-distinctive ones. Quite possibly all three make separate contributions on retention and recall.

Gender, information processing and retention

Studies in the past like the studies of Burgner&Hewstone, 1993 and Georgiou,1999 on attribution pattern between boys and girls indicated that males vary from females in their attribution patterns and scholastic achievement. Further studieson gender difference in cognitive processes and intellectual abilities by Hall & Lucas in Klein 2004, and studies on gender by Hyde (2004) and Maccoby (1987), showed that there is an overlap in this aspect between both sexes with insignificant difference and they also showed that the difference between males and females had disappeared. The analysis of the results obtained showed that difference exists in retention between boys and girls but it isnot significant. The mean retention levels of boys and girls 70.890 and 71.623 respectively, revealing that female students had higher level of retention of learnt of .733 than boys. The difference observed between boys and girls agree with previous studies and recommendations of past scholars and researchers that are mentioned below. For example, the difference in the scholastic achievements of boys and girls are generally attributed to biological causes and /or cultural and stereotypes (Klein, 2004). It was concluded that males have better math and visuo – spatial skills (the kind of skills an architect needs to design a building's angle and dimension) than females, whereas females have better verbal attitudes than males. Subsequently, Maccoby (1987) concluded that the verbal differences between females and males had virtually disappeared, but that the math and visuo-spatial differences persisted. Experts in the study of such as Hyde (1993, 2004; Hyde and Mezulis, 2001), believe that the cognitive differences between females and males have been exaggerated. For example, Hyde (2004)

points out that there is considerable overlap in the distribution of females and males scores on math and visuo-spatial tasks. In a personal study by the U.S. Department of Education (2000), boys did slightly better than girls at Mathematics and science. Overall, though, girls were far superior students, earning better grades and were significantly better than boys in reading. In another national study, females had higher reading achievement and better writing skills than males with the gab widening as students progressed through school. It will not be out of place therefore to conclude that the insignificant difference that occurred between boys and girls in this study is probably because the girls put in more effort than the boys in their work or the no significant difference between the males and females can be said to follow the popular saying that what a man can do a woman can do also and even better.

Subject, information processing and retention

Learners are oriented towards different subjects, while some are Arts oriented, others are science oriented. In many Nigerian schools today, you find students who take only science subjects and those who take only arts subjects. Students in both groups are well able to engage in problem solving even though they use different approaches. The result of the analysis of data showed that difference exists in retention between Arts and Science students and the difference is significant. The mean retention levels of Arts and Science students were 67.0946 and 75.3289 respectively, revealing that science students had higher retention of learnt materials of 8.2343 than the Arts students. From the human learning point of view, science oriented students are more of convergers and Art oriented students are more of divergers. Convergers do well in school and examination, they score highly in test and intelligence andtheir best subjects seem to be Science and mathematics, while divergers like Art subjects, they love music and other forms of arts, they perform best in open ended tests than in intelligence test. Their inquisitive nature makes them seem disturbing from their

teacher's point of view and so they are not as popular with their teachers as their counterparts in Science. Both groups differ in their approaches to critical thinking, creativity and problem solving. Based on the description above, it is therefore not surprising that the science students scored higher in the test given in the study and the test was not an open ended test. So, it didn't favour the divergers who might have been among the Arts group.

There were some past researches conducted on convergence and divergence. For example, Getzel and Jackson (1962) studied the relationship between creativity and intelligence using 449 boys and girls aged twelve and seventeen years, of a private school in Chicago. The mean I.Q of these subjects was 132 point with a standard deviation of 15. One group was high in creativity and the other group high in intelligence. The performance of these two groups was compared in school attainment and popularity in the school. These were their findings:

1. The divergers equaled the convergers in school attainment – achievement
2. The groups did not differ in their mean achievement motivation.
3. The convergers were more popular in the estimation of the teachers than the divergers.

Hassan and Butcher (2011) partially replicated Getzels and Jackson's experiment. They used 100 boys and 75 girls of a second year Scottish comprehensive school. One of their findings was that there was a considerable overlap between divergent and convergent thinking. Both convergent and divergent thinking require critical thinking skills to be effective. Both are used for solving problems, doing projects and achieving objectives. In other words, convergent and divergent thinking are two sides of the same coin of critical thinking. Some individual students in the Arts group had the same high scores with some of the science students which points to findings in the above studies. But on the general Arts students performed lower which goes against the idea that normally Arts students should do

better in languages. This difference might be because the I.Q. of the participants in this study was not established at the beginning of the study and most of them might not be necessarily divergers with I.Q. that is above 120. No wonder then that there is significant difference in the retention level of both science and arts student. The significant difference might be probably becausethere were more science students that had higher I.Q. than the Art students and probably they quickly memorized the items that they processed.

Ability level and retention

In the academic set up, learners are distributed in to different ability levels in their performance. It is reflected in the normal curve which indicates how naturally, learners are assigned to different levels with the majority learners in the middle of the curve and a few in the two extreme ends. In this study, there are three ability groups. The capacity of the students to engage themselves meaningfully in any educational work depends on their ability levels. The performance of the three groups differed significantly from each other. The high ability group differed from the average group by 27 points and from low ability group by 47 points while the average group differed from the low ability group by 19 points. The finding of the study does agree with the fact that students are not the same, that there is disparity in their ability to perform certain tasks. Several studies within the Nigerian environment have shown that learners are qualitatively different in both their ability levels, cognitive structures, hence the difference in learners' performance. In one of such studies conducted by Adeyemo in 2010 on students' ability level and competence in problem-solving in Physics, he found out that students' ability has significant influence on problem-solving tasks. For David and Floyd in Adeyemo (2010), high ability learners are more intelligent than the medium and low ability students. Mortimore in Adeyemo reported that the performance of the low ability is below average and he attributed the causes to under-achievement, social disadvantages (low income, poor health), peer influence on educational choices and quality of teaching. In this

study, the finding does not however fit in to the normal distribution, it is positively skewed as many students scored above average, this could have resulted from many factors like previous knowledge, familiarity with the learning material.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a summary of the study and the conclusion. Recommendations are offered to teachers, curriculum planners and parents on how to improve retention of learnt materials through the levels of processing theory.

5.2 Summary

This study was conducted to find out the effect of levels of processing on retention of learnt materials. Learning is the primary condition for retention. If there is no learning, there will be nothing to retain. The levels of processing model of human memory describe different levels of encoding and processing information. It holds that memory or the ability to recall is determined by the depth of processing. This study set out to ascertain whether shallow processing leads to impoverished memory trace and semantic processing leads to longer lasting memory trace. Human memory is one of the tripod on which hangs the totality of human behavior, the other two being learning and perception. But human memory has its own imperfection as can be seen in how quickly human beings forget their experiences. This can be due to poor processing.

To set a proper pathway for this study, objectives were set, research questions generated and hypotheses formulated. To achieve the set objectives, a research methodology was designed and used. It is a quasi-experimental study with a simulated before and after research design. The experiment involved inducing subjects to process words at the three levels of processing.

In the review of related literature, there are models of human memory like multi-store model, working memory model and the levels of processing model. The levels of processing generally proposed that the level at which an event is coded in the cognitive system will

determine later recall and recognition of the event. It postulates that processing efforts affect the duration of the memory trace. Retention of learnt materials in the levels of processing framework refers to the idea that encoding at the shallow level results in less durable memory trace than "deeper" processing. The levels of processing states that the more analysis an item receives the better it will be remembered. Retention is simply the storage of what has been learnt.

There are factors that affect information processing, they include motivation, personality, mood and heredity and environment Processing breakdown can occur for various reasons such as lack of rehearsal of information before it gets to the STM, interference etc. The levels of processing affect retention differently. The deepest level leads to higher level of retention.

Researches in the past like ones conducted by Lightbody, Siann, Stocks & Walsh, 1996, and Smith, Sinclair & Chapman, 2002) reveal that different sexes process and retain information differently. As the studies went on, an overlap was evident and eventually the difference is said to have disappeared. An insignificant difference was found to between males and females in this study. Learners have different subject orientation. While some are arts oriented, others are science oriented. Both groups approach problem solving differently. This study has clearly shown that meaningful learning yields good retention, recognition and recall results.

This study was conducted to find out the effects of levels of processing on retention of learnt materials. To do this, two hundred students, boys and girls, science and arts students were selected from five senior secondary schools inJalingo. The control group was pre-tested and the treatment which involved inducing the experimental group to process words on the instrument of the study at the three levels of processing was given and they were immediately post-tested. Different statistical techniques were used to test the hypotheses.

The trend in the key finding is that the deeper the processing of learnt material, the higher the retention level.

5.3 Conclusion

This research work and other research works conducted in other parts of the world have shown that the claims of the levels of processing theory contain some truth. Namely, that deeper semantic analysis leads to easier and higher retention and recall. It means that information processed at the shallow level does not impinge on the memory store as strong as the processing done at the deepest level. Other variables like intelligence, nature of elaboration and distinctiveness of material aid easier recall of semantic processing. All students, boys and girls, process information particularly in language area in ways not significantly different from each other. Science and Art students use different approachesto problem-solving. The level of processing has no doubt led researchers to more fully appreciate the role of encoding processes in determining memory performance.

5.4 Limitations

This research was restricted only to five senior secondary schools. This was because it was aquasi-experimental study. The instrument developed for the study was based on English language. The samples were limited to the population of students of some senior secondary school inJalingo,Taraba state. Therefore, the results and conclusions are restricted to the population from which it was drawn. Further studies would have been undertaken before conclusions can be made or extended to the whole of Taraba state and the entire country.

5.5 Recommendations

1. Learning materials should be developed and arranged in a way that fosters semantic processing.
2. Learners should be enlightened on the need to understand the meaning of what they are learning.

3. Teachers should guide learners on how to process learning materials at the deepest levels.
4. Students should be taught with instructional aids and examples that enable them to make associations; thinking of one thing helps bring the other to mind.
5. Teachers should introduce learners to general concepts before going to specifics.
6. Shallow processing should be discouraged as it is of little assistance to the task of retention and recall.

5.6 Suggestions for Further Study

1. Replication of this study with more subjects would add more weight to the findings in this study. Also subjects from other academic situations would provide more convincing support for applying the result of this study to wider populations.
2. Further research is needed in to whether deeper levels of processing or the time taken to process is the specific cause of greater retention level.

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Appendix i

Pre-processing of learning material instrument.

Instruction: Learn all the following words. You have four and half minutes

Furious	Consumers
Shares	Arrogant
Pew	Hawkers
Abscond	Amulet
Persuasion	Seedlings
Grains	Mortar
Billboard	Ritual
Knife	Siblings
Atheist	Rooster
Calf	Harvester

Appendix ii

The processing inducer (treatment instrument). (Shallow/orthographic level questions)
Read the following questions and tick **YES** *or* **NO**

1. Is this word **'PEST'** printed in capital letters? YES [ ] NO [ ]
2. Is the word **'HUMOUR'** printed in capital letters? YES [ ] NO [ ]
3. Is the word **'DILEMMA'** printed in capital letters? YES [ ] NO [ ]
4. Is the word **'infirmity'** printed in capital letters? YES [ ] NO [ ]
5. Is the word **'waves'** printed in capital letters? YES [ ] NO [ ]
6. Is the word **'QUENCH'** printed in capital letters? YES [ ] NO [ ]
7. Is the word **'residents'** printed in capital letters? YES [ ] NO [ ]
8. Is the word **'human'** printed in capital letter? YES [ ] NO [ ]
9. Is the word **'QUESTION'** printed in capital letters? YES [ ] NO [ ]
10. Is the word **'prohibit'** printed in capital letters? YES [ ] NO [ ]
11. Is the word **'tender'** printed in capital letters? YES [ ] NO [ ]
12. Is the word **'timid'** printed in capital letters? YES [ ] NO [ ]
13. Is the word **'cloth'** printed in capital letters? YES [ ] NO[ ]
14. Is the word **'fungus'**printed in capital letters? YES [ ] NO [ ]
15. Is the word **'teacher'** printed in capital letters? YES [ ] NO [ ]
16. Is the word **'DIVIDENDS'** printed in capital letters? YES [ ] NO[ ]
17. Is the word **'ENCOMPASS'** printed in capital letters? YES [ ] NO [ ]
18. Is the word **'HOSTILE'** printed in capital letters? YES [ ] NO [ ]
19. Is the word **'aunty'** printed in capital letters? YES [ ] NO [ ]
20. Is the word **'sweat'** printed in capital letters? YES [ ] NO [ ]

Read the following questions and tick YES or NO (Deeper/phonological level questions)

1. Does the word **'dew'** rhyme with view? YES [ ] NO [ ]
2. Does the word **'hoe'** rhyme with toe? YES [ ] NO [ ]
3. Does the word **'thirst'** rhyme with thus? YES [ ] NO [ ]
4. Does the word **'quit'** rhyme with quite? YES [ ] NO [ ]
5. Does the word **'obstinate'** rhyme with oblivion? YES [ ] NO [ ]
6. Does the word **'leisure'** rhyme with measure? YES [ ] NO [ ]
7. Does the word **'fence'** rhyme with tense? YES [ ] NO [ ]
8. Does the word **'graze'** rhyme with grace? YES [ ] NO [ ]
9. Does the word **'seat'** rhyme with meat? YES [ ] NO [ ]
10. Does the word **'knees'** rhyme with niece? YES [ ] NO [ ]
11. Does the word **'theft'** rhyme with left? YES [ ] NO [ ]
12. Does the word **'chair'** rhyme with share? YES [ ] NO [ ]
13. Does the word **'pure'** rhyme with poor? YES [ ] NO[ ]
14. Does the word **'twist'** rhyme with twig? YES [ ] NO [ ]
15. Does the word **'stove'** rhyme with glove? YES [ ] NO [ ]
16. Does the word **'bath'** rhyme with faith? YES [ ] NO [ ]
17. Does the word **'pupil'** rhyme with poppy? YES [ ] NO[ ]
18. Does the word **'seize'** rhyme with cease? YES [ ] NO [ ]
19. Does the word **'cushion'** rhyme with capture? YES [ ] NO [ ]
20. Does the word **'mansion'** rhyme with tension? YES [ ] NO [ ]

Read the following questions and tick YES or NO (deepest/semantic level questions)

1. Would the word **'furious'** fit the following sentence:
   He was _____ at his fiancée because she decided not to marry him just a day before the wedding day. YES [ ] NO [ ]

2. Is the word **'calf'** a baby pig? YES [ ] NO [ ]

3. Would the word **'harvester'** fit the following sentence:

   He wants to prepare the land for planting, he needs to use a ____ YES[ ] NO [ ]

4. Is the word **'rooster'** a type of wild animal? YES [ ] NO [ ]

5. Is **'knife'** something we use to cut vegetables? YES [ ] NO [ ]

6. Would the word **'consumers'** fit the following sentence:
   The improvement in the quality of their product has led to a rise in the number of _____. YES [ ] NO [ ]

*7. Would the word **'atheist'** fit the following sentence:*
   He told them that he doesn't believe that there is God, they realized then that he is an _____ . YES [ ] NO [ ]

8. Is the word **'siblings'** referring to brothers and sisters in the family. YES [ ] NO [ ]

9. Would the word **'grains'** fit the following sentence:
   She arrived from the farm with only a few _____ of rice. YES [ ] NO [ ]

10. Is the word **'mortar'** a farm implement? YES [ ] NO [ ]

11. Is the word **'billboard'** something we use to trap fish? YES [ ] NO [ ]

12. Is the word **'ritual'** something we get from stock exchange? YES [ ] NO [ ]

13. Would the word **'abscond'** fit the following sentence:
    They kept watch at the door to ensure that he doesn't _____ with their money. YES [ ] NO [ ]

14. Is the word **'amulet'** a type of farming activities? YES [ ] NO [ ]

15. Is the word **'seedlings'** something you find in animal husbandry? YES [ ] NO [ ]

16. Would the word **'persuasion'** fit the following sentence:

She was able to get him go for the conference, she has a strong power of _____. YES [ ] NO [ ]

17. Is this word **'hawkers'** referring to fishing tools? YES [ ] NO[ ]

18. Would the word **'pew'** fit the following sentence:
Three young girls sat on the new _____ during the church service. YES [ ] NO [ ]

19. Would the word **'arrogant'** fit the following sentence:
Joy has an amazingly pleasant attitude towards people, she doesn't see herself as more important than others. She is really _____. YES [ ] NO [ ]

20. Would the word **'shares'** fit the following sentence:
The principal is very keen on getting all his staff buy _____ in the Dangote group of companies. YES [ ] NO [ ]

Appendix iii
Post-processing of learning material instrument.

Gender---------- Subject ----------

Instructions: *Please tick all the words that you learnt or answered questions on(highlighted words in the test (20 words), you have 10 minutes. Thank you!*

Cushion	Obstinate	Grape	Seize	Logical
Furious	Diary	Grains	Doubt	Fragment
Dance	Weave	Tolerant	Encompass	Seat
Angel	Dilemma	Mortar	Motel	Violation
Dew	Enemy	Power	Mansion	Prohibit
Arena	Infirmity	Flash	Nanny	Plait
Calf	Pulse	Fungus	Tower	Ritual
Arrow	Bloom	Pasta	Arrogant	Rampage
Concubine	Leisure	Latch	Transmit	Knees
Harvester	Route	Larva	Crooked	Gracious
Medium	Expulsion	Teacher	Cushion	Shallow
Board	Waves	Familiar	Chair	Abscond
Hoe	Fleet	Seedlings	Flesh	Clown
Brass	Planes	Trait	Hostile	Track
Thirst	Atheist	Persuasion	Supreme	Tender
Brick	Pepper	Beer	Beautiful	Amiable
Range	Spectacular	Manic	Aunty	Timid
Quit	Quench	Pupil	Lorry	Cough
Inquire	Flour	Thorn	Stock	Sense
Bully	Fence	Chess	Sweat	Tutor
Humour	Storm	Hawkers	Store	Theft
Graduation	Graze	North	Frown	Drama
Rooster	Lobby	Commercial	Shares	Spark
Compulsion	Trick	Stove	Crane	Chair
Pest	Residents	Trace	Question	Crumb
Horse	Trial	Bath	Cane	Cloth
Knife	Siblings	Spear	Twist	Sluggish
Dress	Anxiety	Viper	Primary	Amulet
Clutches	Human	Pew	Billboard	Appreciate
Consumers	Athlete	Dividends	Austere	Pure

Appendix iv

The reliability analysis for the processing inducer (treatment instrument)

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.794	2

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
49.8667	178.120	13.34614	2