
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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ABSTRACT

This research work was carried out to find the effects of levels of processing on retention of learnt materials. Two 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 (SSII) was selected from a population of 6,390 senior secondary school students of five Government Day Senior Secondary School students in Jalingo 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 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. The experimental group scored higher than the control group. The major finding in this study therefore follows the trend that the deeper the level of processing the better the retention. Following all the findings in this study, it was suggested that teachers should guide learners to process learning materials at the deepest level.

INTRODUCTION

Education is seen as the backbone of any nation. 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. Education produces professionals and effective working class members of the society (Abdulai, 2010).

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 at a higher level. The diversified curriculum is aimed at meeting the needs of students according to their different talents, opportunities and future roles.

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. Many factors have been established as responsible for such mass failure in public examination but 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. The levels of processing model holds that 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. (Sanrock, 2004) 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). 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?

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 show that, the more analysis an item receives the better it will be recalled.

The levels of processing approach are 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.

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.

In recent years, results of WAEC and NECO show massive failure of candidates. Only a small percentage is able to pass the required standard. For example, the summary of the WAEC result in Taraba state of the percentage of those who passed the exams in the past years is as follows: 2008 - 8.7%, 2009 -

10%, 2010, 2011 – 15% and 2012 – 25%. (Ministry of Education Taraba State). This poor performance 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? What are the effects of levels of memory processing on the students' level of retention?

This study therefore investigated the effects of levels of processing information on retention of learnt materials and to establish the difference in retention between the different ability groups among senior secondary school students in Jalingo Local government area of Taraba State and tested the following hypotheses at 0.05 level of significance.

H₀₁. There is no significant difference in retention of learnt materials among the three levels of processing information.

H₀₂. There is no significant difference in the level of retention male and female students.

METHODOLOGY

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. 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.

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 6390. Five schools were randomly selected and since it is a quasi-experimental study, 200 samples were randomly selected.

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.

This 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.

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. 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.

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.

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. A pilot study was conducted using 50 students from G.S.S.S.S Jalingo. 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.

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.

Phase two: Treatment (processing)/Post-test

The treatment groups 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?" For the deeper/phonemic level, another group of subjects was asked questions like: "Does the word 'moon' rhyme with 'soon'?" And for the deepest/semantic level a different group of subjects

was asked questions like: "Is the word 'apple' a type of fruit?" or would a given word fit a given sentence. 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 data collected in this study was analyzed through the use of descriptive and inferential statistics. Univariate analysis of variance was used to analyze the hypotheses.

RESULTS AND DISCUSSION

Research question: Is there any 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.

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 difference in 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.

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.

FINDINGS

1. The mean retentionscores of three levels of processing information differ from the mean retention of the control group.
2. 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.

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. ($t=2.38, P=.812$).

DISCUSSION OF RESULTS

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:

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 score 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 of Craik and Lockhart (1972), Craik and Tulving (1975), Kanegi (2009), and Gargano (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%.

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 et al, 1977). 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 phonological level contributes to higher retention of learnt materials than the orthographic level. 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. 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. 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. 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.

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 studies on 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 is not 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. 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 gap widening as students progressed through school. 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.

RECOMMENDATIONS

1. Students should be enlightened on the levels of processing information.

2. Learning materials should be developed and arranged in a way that fosters processing at the deepest level.
3. Teachers should introduce learners to general concepts before going to specifics.

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