Appropriateness of Mnemonic Techniques on Serial Learning Outcomes in Primary SchoolsinMachakos Sub-County, Kenya

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Abstract: The objectiveof this study was to investigate the appropriateness of Mnemonic techniques on serial learning outcomes in upper primary schools in Machakos sub-county, Kenya.To achieve this, factorial-experimental research design was used.Schools were first stratified into three educational zones of Machakos Sub-County.Purposeful sampling technique was used to select four schools with similar mean grades in 2017 KCPE exams from the three zones.Simple random sampling was used to assign intact groups (streams)to experimental and control groups.A sample of 317 pupils was selected from class 7 pupils to participate in the study.The study used the following research instruments:Questionnaires which were used to measure level of satisfaction among learners during Mnemonic techniques treatment process. Testswhich were used to measure serial learning outcomes. Observation schedule which was used as a monitoring tool during Mnemonic techniques treatment process.The validity and reliability of the research instruments was established by piloting the instruments in one of the primary schoolselected from the neighbouring Kathiani Sub-County.The reliability of the research instrument was determined through the split-half correlation method. Two-way ANOVA was used to analysethe data.Post-hoc Pairwise comparison (LSD) was performed to establish which groups had significant differences. The results were analyzed descriptively and inferentially. The main findings of the study were; Data revealed that significant differences(F(3,317)= 4.70, P< 0.05)existedbetween learners using Mnemonic techniques in relation to serial learning outcomes.Post-hoc analysis showed thatMusic wasthe most appropriate Mnemonic technique for serial learning tasks, Pegword, keyword and control groupwere second, third and fourth respectively.The study recommendedMinistry of education through Kenya institute of curriculum development (KICD) should in cooperateMnemonic techniques in the curriculum.

Key Terms: Appropriateness, Mnemonic technique, serial learning, learning outcomes, keyword, pegword.

I. INTRODUCTION

The term Mnemonic means "aiding the memory. "Thus a Mnemonic technique is a system or technique which aids the memory. Mnemonics generally refers to methods of memory improvement, Thomson (2005). Typically, however, the term is used to refer more specifically to artificial memory techniques, the kinds of techniques recommended in popular memory-training books. They would include such techniques as visual imagery, verbal mediators, stories, rhymes, acrostics, and acronyms.

Mnemonic techniques are memory aids that assist one in remembering specific information by using a process, strategy, or technique that enables a person to improve memory, (Higbee, 1977). The use of Mnemonic systems dates back more than twenty centuries, (their history range from about 500 B.C. though the seventeenth century has been traced by Yales, 1966).Mnemonic techniques are also encoding strategies used to organize and/or chunk to-be-learned material in order to make it more meaningful and easier to remember.

At a conceptual level, Mnemonics boosts memory due to at least three factors. First, they involve deliberate, or effortful, learning (Bellezza, 1996); the focused attention the learner pays to the materials while using and/or creating Mnemonics supports encoding to long-term memory. Second, they connect new knowledge with established schemes in long-term memory, a process also known as elaboration, which enhances encoding and supports successful retrieval, (Balch, 2005). Third, many Mnemonic devices require the integration of two or more information codes (e.g., verbal, visual) which, consistent with Paivio's (1986) dual-coding theory, hence enhancing memory by providing multiple routes to retrieval. The use of mental imagery may be particularly important; some researchers recommend using interactive, dynamic, distinctive, and

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possibly even bizarre images (McDaniel & Einstein, 1986; McDaniel, Einstein, DeLosh, May, and Brady, 1995) and spending at least 6 seconds on each visual association (Bugelski, 1974). Mnemonics are useful only for recall, and they are not comprehension strategies (Bakken & Simpson, 2011); Mnemonics only facilitate the recall of new knowledge.

Mnemonic techniquesare systematic procedures for enhancing memory. They are used in developingbetter ways to encode information so that it will be much easier to retrieve,Brigham, Scruggs, and Mastropieri, (1995). Mnemonics techniquesare memory devices that enable students to remember information moreeasily and effectively. Mnemonics perform this function by connecting the new, unfamiliarinformation that must be learned and remembered with information that is already known bythe learner by the use of visual and auditory cues (Mastropieri, Sweda, & Scruggs, 2000).Mnemonic techniques such as acrostics and acronyms, have facilitated individuals to recallinformation by making new information more familiar, meaningful and concrete (Bakken &Simpson, 2011). These devices are effective and are used by students to recall information on various subjects. Young adult learners have used Mnemonics techniquesto improve their vocabulary knowledge (Bakken & Simpson, 2011).Mnemonictechniques accelerate the rate of acquisitionof new knowledge in elementary accounting and help to enhance formal reasoning (Laing,2010).

Mnemonictechniques aid the memory in encoding, retaining and retrieval. The term may also refer more specifically to rather unusual, artificial memory techniques,the kinds recommended in popular memory-training books (e.g., stories, rhymes, acronyms, verbal mediators, visual imagery).Mnemonictechniquescan be used over and over to learn different sets of material (Morris, 1977).

Research evidence indicates that to make visual association effective, imagery must both be "visual" and involve "association,"(Higbee 1979). Interacting imagery are more effective than separated images in paired-associate learning (Begg & Anderson, 1976; Kerst, 1976; Nelson, Greene, Rank, Hatchett, &Igl, 1978). The advantage of interacting imagery over separate images has been well-supported by research evidence, and future efforts may be more beneficially aimed at theoretical explanations for the effect (e.g., Begg, 1978; Reese, 1977).Key strengths of Mnemonic advantages as a teaching tool stems from the fact that imagery Mnemonic does not require literacy among the learners, they are easy to learn and difficult to forget. Mnemonictechniques are useful with large number of people, and it is cost effective because images are inexpensive to construct, easy to transport, they do not wear out, never rust or need no paint, (Higbee, 1978).

Onur, Ali, Yunus, and Musa, (2013), in a study to investigate the effect of the letter/phonetic method on nurses' attainment of basic knowledge of the healthcare system, and nurses' recall of this basic knowledge. They used sample of 76 subjects. In the experimental group of 39 subjects who were taught using Mnemonic techniques and control group of 37 subjects. Using a t-test, the findings showed that there was a significant difference between the experimental and control groups, (t = 9.35, p = 0005), in favor of the experimental group that employed letter-phonetic Mnemonics. Three weeks after instruction, the participants were tested again; and the attainment test was given as a Retention test (Onur et al., 2013). Using a t-test, the researchers showed that there was a significant difference again between the experimental and control groups, in favour of the experimental group that employed letter-phonetic Mnemonics (t = 12.73, p = 0.05).

Levin and Cormick (2009), designed a study to explore issues regarding use of Mnemonic techniques in a systematic procedure for improving one's memory. Seventh and eighth grade students were presented with fictitious biographies to remember. Keyword students were instructed to use a prose-learning adaptation of the Mnemonic keyword method, and control students were left to their own devices. In the initial experiment, each of three variations of the keyword method, differing in terms of the manner in which the Mnemonic images were organized, resulted in significantly higher levels of recall than did control instructions. Moreover, the keyword groups could be distinguished from the controls, as well as from one another, on the basis of qualitative differences in their recall patterns. The researcher in current study compared pegword, keyword and music Mnemonic techniques on serial learning outcomes for both immediate and delayed recall. The literature on Mnemonic techniques is very sandy in Kenya and Machakos County. Hence forming the bedrock of this study.

Learning involves connecting new information with existing concepts, knowledge and experience. Hence, new information is linked to existing knowledge by the learner to form new knowledge, and this process is known as constructivism. The links are stronger if they involve recent vivid, multisensory experiences, encountered in the learning process (Petty, 2009). Thomson (2005) continues to say that early and late items may not have to compete as much for rehearsal resources as the middle items. Middle items have more of a likelihood of being interfered with from earlier and later items, while the initial and terminal items do not have to face as much interference.

Research findings show a chronic deficiency in learning outcomes across the country. It has been established that many children of primary school age, including those enrolled beyond Standard 3, are not able to pass verbal learning outcome tests. Even in Standard 7, one in ten pupils cannot pass both the English and

Numeracy tests. The current study soghtto find out appropriateness of Mnemonic techniques by comparing keyword, pegword and music Mnemonic techniques withserial learning tasks.

Objectives of the Study
To find out whether thereare differencesin serial learning outcomes between learners taught using keyword,pegword and Music MnemonicTechniquesPublic upper primary pupils.

The null hypothesis of the Study
H_0: There is no significant differences in serial learningoutcomesbetween learners taught using Keyword, Pegword and MusicMnemonic techniquesin Public upper primary pupils

II.   RESEARCH METHODOLOGY
Research Design
Research Designis arrangement of conditions for collection and analysis of data in a manner that aims to combine relevanceto the research purpose with economy in procedure, (Kothari, 2004).

Factorial-experimental research design was adopted.Factorial-experimental setup consists of multiple factors and their separate and conjoined influence on the participants in the experiment.According to Trochim(2004),amain effectin factorial -experimental design is an outcome that is a consistent difference between levels of a factor.Aninteraction effectexists when differences on one factor depend on the level you are on another factor. In the current study, learning outcomes ofthree Mnemonic techniques (Pegword, Keyword and Music) were investigated simultaneously at two levels (immediate and delayed recall).

Research Variables
According to Kothari (1985), if one variable depends upon or is a consequence of the other variable it is termed as dependent variable. The variable that does not depend on other variable is termed as independent variable.

The independent variables were three mnemonic techniques (pegword, keyword and music). Thedependent variable was serial learning outcomes.

Location of the Study
The study was carried out in Machakos Sub-County, Machakos County, Kenya. The head-quarter of Machakos county is Machakos town. Machakos townis located 64km South East of Kenya's capital Nairobi and 30 minutes' drive from the Jomo Kenyatta International Airport.

Target Population
The target population comprised all 92 public primary schools in Machakos sub-county. The accessible population was class seven pupils from 75 public primary schools. The choice of the schools was based on that the schools had similar mean grade in KCPE examinations in 2016 and 2017.
Sampling Techniques
Stratified, Purposeful and random sampling techniqueswere used in the current study to select public primary schools and pupils to participate in the study.A sample size of 317 pupils were selected from class 7 to participate in the experiment in the four selected schools.

Research Instruments
The researcher used the following research instruments:

Achievement tests
Post-test achievement tests were used to measure serial learning outcomes after the learners were exposed to learning through mnemonic treatment intervention. There were two types of Achievement tests.Radom assessment tests (RATS) and Continuous assessment tests (CATS)were administered to pupils immediately after the lesson and two weeks three weeks after intervention process respectively.

Pupils Satisfaction Survey Questionnaires
Participants from the three experimental groups were given pupils' satisfaction survey questionnaires to fill at the end of the treatment period.

Observation Schedules
The observation schedules were used as a monitoring tool during Mnemonics intervention process.

Pilot Study
Ten percent of the total sample size was used for the pilot study. Data collection for the pilot study was conducted on 32 pupils from a primary school in theneighbouring Kathiani Sub-county.

Data Collection
Three stages were adopted as procedure of data collection and experiment. These stages were:

Stage one; Initial Mnemonic Training
The researcher started by first training teachers and two research assistants on how to use the three Mnemonic techniques instruction methods.The content that was used to initially train teachers was drawn from first term class seven syllabus.

Stage Two: MnemonicInstruction
In the Mnemonicinstructionstage, two main methods of instruction methods wereused in this study:TheMnemonic instruction methodsfor the three treatment groups andconventionalmethod of instruction for control group. This stageinvolved intervention process where pupils in thethreetreatment conditions received Keyword, Pegword and MusicMnemonic instruction during teaching and learning process.
Observation schedule were used to monitor how teachers are teaching using Mnemonics instruction method.

Stage three: Measurement of Serial Learning Outcomes
Post-test achievement tests for different learning tasks were administered after intervention process of Mnemonic instruction method to allthe three treatment groups and control group to measure serial learning outcomes. Achievement tests were administered at two levels: Immediate recall and delayed recall.

Data Analysis
The purpose of data analysis is to reduce data to intelligible and interpretable form so that the relations of research objective can be studied and tested. Two-way Analysis of variance was used to analyse the data. Post-hoc Pairwise comparison by Least square difference (LSD) was performed to establish which group(s) had significant differences.

III. FINDINGS

Appropriateness of Keyword, Pegword and Music MnemonicTechniques on Serial Learning Outcomes
Regarding the studyobjective, the researcher sought to investigate whether there are differences in serial learning outcomes between learners using keyword, pegword and Music Mnemonic techniques. In order to obtain data, post- test scores were obtained after intervention process of the three Mnemonic treatments groups and a control group. The data was analysed and presented descriptively and inferentially.

Descriptive Analysis for Mnemonic techniques scores on serial learning outcomes
In order to establish the differences in serial learning outcomes between learners using keyword, pegword and Music Mnemonic techniques the raw data was first analysed descriptively. Table 1 presents the findings.

Table 1: Descriptive analysis for Keyword, pegword and Music MnemonicTechniques and Control Group on Serial Learning Outcomes

Mnemonic Device	Type of assessment	N	Minimum	Maximum	Mean	Std. Deviation
Pegword	RAT	41	13.00	78.00	49.68	15.09
	CAT	41	30.00	90.00	59.02	15.98
Keyword	RAT	35	19.00	71.00	49.57	12.02
	CAT	35	26.00	83.00	57.89	14.18
Music	RAT	50	27.00	77.00	55.56	11.71
	CAT	49	27.00	89.00	62.37	18.60
Control Group	RAT	38	20.00	86.00	46.55	17.71
	CAT	36	24.00	78.00	54.44	12.61

Table 1 show that there were mean differences between the three Mnemonicinstruction methods and control group. Music had the highest mean scores (62.37,55.56) and standard deviation (11.71,12.61) for the CAT and RAT respectively, pegword was second with mean score (59.02,49.68) and standard deviation (15.09,15.98)CAT and RAT respectively, keywordwas third with a mean score (57.89, 49.57) and standard deviation (12.02,14.18) CAT and RAT respectively,finally control group recorded the lowest mean (54.44,46.55) and standard deviation (17.71,12.61) CAT and RAT respectively. Descriptive statistics also show that there were mean differences between the factor B (two type of assessment) across all levels of factor A (Mnemonic technique). The mean scores of CAT (delayed recall) were higher than the mean scores for RAT (immediate recall) across all levels of factor A (Mnemonic technique) instruction methods and control group.

This implies that learners scored higher marks for delayed recall than when tested for immediate recall in allMnemonic technique instruction methods.

Inferential Analysis for MnemonicTechniques Scores on Serial Learning Outcomes

To test the null hypothesis (H_0:) which stated that, there is there is no significant differences in serial learning outcomes between learners using keyword, pegword and music Mnemonic techniques, a two-way ANOVA was done and where significant differences were identifiedpair wise comparison was performed. The second hypothesis was sub-divided into two supplementary hypotheses asfollows:

i. To investigate whether there are significant differences between factor A (Mnemonic technique)and learning outcomes.
ii. Toinvestigate for significant differencesbetween factor B (type of assessment).

Table 4.3: Two-way ANOVA test analysis forMnemonic technique on serial learningoutcomes

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8516.853[a]	7	1216.70	5.40	.000
Intercept	944504.252	1	944504.25	4183.90	.000
MnemD	3180.046	3	1060.02	4.70	.003
ToA	5223.100	1	5223.10	23.14	.000
MnemD * ToA	74.009	3	24.68	.11	.955
Error	71561.959	317	225.75		
Total	1052891.000	325			
Corrected Total	80078.812	324			

Supplementary hypotheses

Two Supplementary hypotheses were analysed individually in order to establishdifferences, between the groups, within the groups and main/interaction effect of factor A and factor B.

i. **$H0_a$: There is no Significant Difference Detween Main effect Factor A(Mnemonic Techniques)andSerial LearningOutcomes**

There were significant differences ($F(3,317) = 4.70$, $P< 0.05$)between learners exposed to learning through the three Mnemonic techniques andserial learning outcomes,Therefore, the null hypothesis was rejected. Further analysis using a post-hoc pairwise comparison (LSD) was done to which group(s) where responsible for the differences.

Table 2: Pairwise comparisons analysis for MnemonicTechnique on Serial Learning Outcomes
Dependent Variable: Observed Score

(I) Mnemonic Device	(J) Mnemonic Device	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
	Keyword	.63	2.45	.80	-4.19	5.436
Pegword	Music	-4.610[*]	2.24	.04	-9.02	-.196
	Control Group	3.855	2.41	.11	-.89	8.596
	Pegword	-.625	2.45	.80	-5.44	4.185
Keyword	Music	-5.235[*]	2.35	.03	-9.85	-.619
	Control Group	3.230	2.51	.20	-1.70	8.160
	Pegword	4.610[*]	2.24	.04	.20	9.024
Music	Keyword	5.235[*]	2.35	.03	.62	9.852
	Control Group	8.465[*]	2.31	.00	3.92	13.009
	Pegword	-3.855	2.41	.11	-8.60	.886
Control Group	Keyword	-3.230	2.51	.20	-8.16	1.700
	Music	-8.465[*]	2.31	.00	-13.01	-3.921

Key:I=mean score of main Mnemonic technique, J=means score other Mnemonic techniques

Music technique had the highest scores across all levels of Mnemonic techniques, followed by pegword, keyword and finally control group scores. These findings imply that music was the most appropriate Mnemonic technique for serial learning tasks. Pegword was more appropriate than keyword, keyword was more appropriate than control group and the control was least appropriate for learning and retaining serial learning tasks.

These results are consistent with studies done previous by Levin and Cormick (2009):Delin (1990) and Carney and Levin (2008) which indicated that there were significant differences in favor ofMnemonicinstruction methods compared to control group. Significant differences were found particularly in keyword and also other Mnemonic techniques for both immediate and delayed recall.

Other studies also agree with these findings includes studies byCarney and Levin (1998), Shriberg, Levin, McCormick, and Pressley (1982), all whoagree Mnemonic techniques were superior in improving serial learning than control group which was using conventional method.

ii.   H0$_b$: There is no Significant Main effect of Factor B (Type of Assessment) on Serial Learning Outcomes

Significantdifferences (F (1,317) = 23.14, P< 0.05)were found to exist between type of assessment on serial learning outcomes.Hence null hypothesis was rejected.Having found significance differences between CAT and RATon serial learning outcomesthe researchersought to investigate further which group(s) were responsible for the differences by performingpost-hoc pairwise comparison (LCD).

Table 4: Pairwise Comparisons Analysis for Type of Assessment in Relation toSerial LearningOutcomes.

(I) Type of assessment	(J) Type of assessment	Mean Difference (I-J)	Std. Error	Sig.^{b}	95% Confidence Interval for Difference^b	
					Lower Bound	Upper Bound
RAT	CAT	-8.089*	1.68	.00	-11.40	-4.780
CAT	RAT	8.089*	1.68	.00	4.78	11.397

Key: CAT= Continuous assessment test, RAT= Radom assessment test
Based on estimated marginal means

The mean of CAT scores was higher than the mean of RAT across all levels of factor A (Mnemonic technique). There was statistically significant differences of type of assessment on observed score. Observed scores of CAT were higher than the observed score of RAT across all levels of factor A (Mnemonic technique). This means that learners scored much higher when tested for delayed recall in all Mnemonicinstruction methods.This findingagree with study doneby McReynolds and Acker (1959) in their studythey investigated serial learning under conditions of rapid presentation of stimuli; with the ratio between inter-stimulus interval and duration of exposure held constant. The subjects were exposed to 12 syllables for 0.082 seconds. Each was using intervals of 0.30, 0.69, and 1.45 seconds. between their successive exposures. The findings revealed that the amount of learning increased with the length of the intervening interval. The findings also agree with Carney and Levin (2008) study, whose findings showed significant advantages of the keyword Mnemonic over a repetition condition, on immediate and 2-day-delayed tests. Surprisingly, this results were contrary to the traditional belief that immediate recall is usually much higher than delayed recall according the famous Ebbinghaus forgetting curve, (Ebbinghaus, 1885, 1909, 2011). The findings seem to suggest that Mnemonic techniques require time to learn and practice before they can be used to by learners to enhance retention and retrieval of information.

IV.   CONCLUSIONS
Appropriateness of Keyword, Pegword and Music MnemonicTechniques on Serial learning outcomes

The study objective had two (2) main conclusions as follows: First, based on the hypothesis that,(H0$_a$):There is no significant difference of main effect factor A (Mnemonic technique) on serial learning outcomes. There were significant differencesbetween Mnemonictreatment conditions and serial learning outcomes.Further analysisindicated thatMusic technique had the highest scores across all levels of Mnemonic techniques, pegword was second and keywordwas least appropriate among three Mnemonic technique treatment conditions. Control group was least appropriate among the four groups. It is researcher's logical conclusion that Mnemonic techniques can be used to improve serial learning outcomes. However, music is the most appropriate while keyword is the least appropriate.

Second,based on the (H0$_b$):There is no significant difference of main effect of factor B (Type of Assessment) on serial learning outcomes.There were significant differences between main effect of factor B (Type of Assessment) and serial learning outcomesFurther analysis indicated that the mean of CAT scores was higher than the mean of RAT scores across all levels of factor A (Mnemonic technique). The investigator's conclusion that learners require time to learn, practice and internalize the Mnemonics techniques before they can be used to enhance learning outcomes that is why the delayed recall was always higher than immediate recall in all mnemonic technique conditions.

V. RECOMMENDATIONS

Based on the findings of the study, the following recommendations for policy and further research were made;

Policy Recommendations

1. The ministry of education need to establish policies that will effectivelysupport integration of Mnemonic techniques in teaching and learning process especially the lower levels particularly the competency based curriculum (CBC). These include;
- Allocating more funds for primary schools and specifically for purchasing relevant materials for Mnemonic techniques.
- Ensuring proper supervision of the teaching process by Mnemonic techniques.
- Ensuring that the content is well integrated with Mnemonic techniques.
2. Existing teachers should be taken for refresher courses on the use of Mnemonic techniques during teaching.

Recommendation for further Research

The researcher suggests that further researches should be carried out on;
The findings of this study have shown that keyword, pegword and music Mnemonic techniques have a positive and significant predictive value on serial learning outcomes. However, the study did not investigate the relationship between serial learning outcomes, there is need to carry out further research to identify the effect of other Mnemonic techniques on social studies.

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