



Generative Learning Model (GLM) and Senior School Students' Retention in probability

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ABSTRACT

This study examined the effect of Generative Learning Model (GLM) on senior school students' (average of 15-years old) retention ability in probability. It adopted a pre-test, post-test, delay test control group involving a 2 x 2 experimental design. The moderating influence of gender on the dependent variable was also investigated. This is an in-situ experiment involving a total of 96 senior school two students who were selected purposively to participate in the study (51 students in the experimental group and 45 students in the control group). Three researcher designed instruments were used for collecting data. The experimental group consists of 24 boys and 27 girls. The t-test statistics was used to control the initial variance. The findings showed that GLM had significant main effect on students' retention ability in probability. Also, there was no significant difference in the mean retention score of male and female taught probability using GLM. The result of this finding implies that GLM is more effective in enhancing students' retention in probability than conventional method of teaching. Thus, mathematics teachers are advised to use GLM to teach their students during mathematics lessons.

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INTRODUCTION

Mathematics is one of the secondary school subjects that has integral impact in every one's life and affects almost every field of human career. Hodanova and Nocar (2016) claimed that mathematics is the basic tool for powering sophisticated numerical manipulations used for advancement in science and technology. Also, mathematics forms the basis of research methods and as such, its contributions goes beyond science but also to other fields of human endeavor. Sam-Kayode and Salman (2015) are of the view that the role of mathematics in national development cannot be over emphasized because of its major contributions towards science and technological advancement. Nosa and Ohenhen (1998) opined that evidence abound to show that nations that embrace

mathematics, science and technology enjoy better standard of living and are less dependent on others. This is because mathematics is the precursor of scientific discoveries and inventions of which any nations that do not take interest in it would remain underdeveloped.

Over the years, the Federal Government of Nigeria has for long been aware of the pivotal position of mathematics to individual fulfillments and national developmental goals with reference to scientific and technological emancipation and breakthrough. This understanding has consequently led Nigeria educational policy makers to position mathematics as a compulsory subject in primary and secondary levels of education (FRN, 2013). At the secondary school level, mathematics curricular consists of five major themes such as,



Number and Numeration, Algebraic processes, Geometry, Statistics and probability and calculus. Hornby (2010) defined probability as the measure of likelihood of the occurrence of an event and random phenomena. Probability is an important branch of school mathematics that has everyday applications in terms of critical thinking, reasoning and in decision making to solve economic, political, social and technological problems of any nation (Sambo, 2015).

Suleiman (2011) and Olubukola (2015) identified probability as one of the abstract, complex and difficult topics in mathematics. Also, students' performance in mathematics has not been satisfactory and the poor performance resurfaces yearly (Ayinla, 2015). Why this is so, and what can be done to increase students' performance and retention in mathematics are the important educational concern (Kajuru & Kauru, 2010). In addition, the West Africa Examinations Council (WAEC) Chief Examiners' reported in 2010, 2011, 2012 and 2015, that Probability has been identified as one of the students' area of weaknesses in mathematics examinations. It was stated that majority of the students who attempted probability questions do not show competence in solving them. This may be due to poor understanding of some concepts in probability and that majority of the candidates did not understand what was meant by mutually exclusive event in probability. However, mutually exclusive in probability means that two events cannot happen at the same time, that is, the occurrence of one event will prevent the occurrence of the other event. For example, we cannot have a 'head' and a 'tail' together when a coin is tossed once. Our argument in this article is such that if students are encouraged to construct their own meaning of instructional materials, effective learning which will help in schema construction and automaton may be ascertained.

Anyor and Iji (2014) stated that for good performance to be achieved,

retention must be in place. Retention is measured in collaboration with performance. This means that closely related to performance is retention. Hornby (2015) defines retention as the ability to remember experiences and learnt materials. Kundu and Tutoo (2002) pointed that retention is preservation of mind. The implication is that the amount of knowledge learnt and kept, skill acquired or generative learning activities reproduced for application in new situations reflects what is retained. Hence, retention is a strong component of performance. If knowledge and skills acquired in probability at a given point is not retained, then its application to daily activities may not be guaranteed and may therefore lead to poor performance in mathematics.

As stated earlier, many students are faced with the challenges of understanding concepts in probability, others who understand could not retain learnt materials. The reasons for these difficulties may vary but this could sometimes be related to the poor teaching method employed by teachers (Chainson, Karumeh & Obida, 2011). Also, Researchers such as Suleiman (2011) and Sam-kayode & Salman (2015) have viewed strategies of teaching as one of the contributing factors to poor performance and retention ability of students in probability.

Steady (2009) suggested that before choosing an appropriate teaching strategy for a particular concept, teachers need to ask questions such as, what do students need to learn mathematically, and what instructional strategies are more effective in teaching mathematics skills? One of the learner-centered teaching strategies for effective learning of mathematics skills is with the use of Generative learning model. Wittrock (1974) an American educational psychologist introduced Generative learning model and it was built on constructivist theory of John Dewey (1938) and Jean Piaget (1973) cognitive theory of



child development. The learning characteristics with constructivist view is that learners construct their understanding about an instructional material and such construct are based on their previous knowledge and understanding of new information.

However, Okpala (2011) suggested that a carefully designed teaching method can make teaching and learning more effective in class. The result of the effective teaching and learning is good performance and invariably leading to retaining subject matter. This study therefore attempts to explore avenues through which retention of probability concepts by senior secondary school students can be made more effective. Hence, the effect of generative learning model on students' retention in probability was examined.

Also, in Nigeria, single gender and co-educational senior secondary schools are the two types of schools setting operating. Each of these school settings was established to bridge the gap of gender bias or inequality existing among students. Adeyemi (2008), Adeneye (2011) and Usman and Musa (2015) observed that male students are more advantageous than their female counterpart in the classroom. Akanmu and Fajemidagba (2013) and Salman and Ameen (2014) revealed no significant difference in the performance of male and female students in Mathematics. Based on gender difference, this study will examine the inconclusive results between male and female students in probability.

Mathematics is a compulsory subject at the secondary school level in Nigeria education system (FRN, 2013). This subject must be passed at credit level before a student could be admitted into any tertiary institutions in Nigeria (JAMB, 2017). Students, parents, mathematics educators, government and the society are worried because of the poor performance of students in mathematics. Evidence from WAEC results indicated that this condition is deplorably high, to the

extent that the percentage pass in mathematics by Nigerian students was below 60% except in 2014 that has percentage of 61.97.

Studies have shown that probability is one of the branches of mathematics that teachers find difficult to teach and consequently students do not perform well on it. Azuka, Durojaiye, Orobosa and Jekayinfa (2013) carried out an investigation into perceived difficult topics by mathematics teachers in Unity schools in Nigeria. It was reported that 48% of the mathematics teachers in the Unity schools specifically considered probability as difficult to teach. The WAEC Chief Examiners' report (2010, 2011, 2012, 2014, and 2015) also indicated that candidates largely attempted questions on probability but failed to show competence in the way the question were answered. This implies that students do not have in-depth knowledge and understanding of concepts in probability which could account for the poor performance of students in the topic and result to generally low performance in mathematics.

Also, there is evidence to lend support to the fact that this poor performance and retention is as a result of non-utilization of appropriate teaching strategies. Despite the application of different innovative teaching strategies in many school subjects in Nigeria (Akanmu & Fajemidagba, 2013; Ameen and Salman, 2014), there is dearth of research on the use of constructivist strategy (GLM) to improve students' retention ability in Nigerian secondary schools. Therefore, this study is set to provide empirical evidence on the GLM as a strategy to enhance students' retention in probability in Ijebu-Ode, Nigeria.

Research Objective

The main objective of this study is to investigate if Generative learning mode enhances students' retention in probability in Nigerian senior secondary schools,



Research Questions

The study provided answers to the following questions which has corresponding hypotheses that were tested at 0.05 significant level:

- i. What is the difference in the mean retention scores of students taught probability using GLM and those taught using conventional teaching method?
- ii. Do male and female students mean retention scores differ when taught probability using GLM?

METHODOLOGY

This study was a quasi-experimental research of the non-randomize, non-equivalent groups involving pretest, posttest and retention scores. It adopted a 2 x 2 factorial design. The independent variables were Generating Learning Model (GLM) and conventional teaching method while the dependent variable was students' retention scores. Students' gender was considered as moderating variable occurring at two levels (male and female). The target population for the study was all the SS II students in Ijebu – Ode, Ogun State, Nigeria. Two public co-educational schools were purposively selected for the study. One Intact Senior school II class was randomly picked and assigned group from each of the selected schools. A total number of 96 SS II students were involved in the study. The experimental group comprises of 51 students (24males and 27females) while the control group was made up of 45 students (21males and 24 females). The ages of the participants ranges between 13 years – 17 years.

Three main instruments prepared by the researcher were used for this study. The first instrument was lesson modules (answering-questions activity) on probability. The second and third instruments were GLM instructional guide and a Mathematics Retention Test (MRT) which consists of 20– items multiple

choice questions and 5 theory questions. According to Davis & Moore (2010), retention can be measured by recalling, relearning and recognizing what has been learnt. All the multiple choice and theory questions are structured to assess students' ability to recall, recognize and transfer schema. The instruments were validated by two experienced senior school teachers and two Mathematics education lecturers in Department of science education, University of Ilorin, Ilorin, Nigeria. The reliability of the MRT was done using test retest method involving 20 students outside the study area within two weeks interval. The result of the test retest was analyzed using Pearson Product Moment Correlation (PPMC) statistics and a reliability index of 0.76 was gotten.

After seeking permission to carry out research from the head of the two selected schools, the consent of the participating students were sought. They are made to realize that they are free to withdraw at any stage of the research. The experimental group was taught probability using Generative Learning Model which gives room for interaction among the teacher, students and the lesson modules. The control group was taught probability using conventional teaching method. The teaching lasted for 4 weeks; administration of pretest was carried out before the actual teaching in the first week, the activities for the second week were to administer treatment to the experimental group and teach the control group conventionally, posttest was given to both groups in the third week; and a delay test or retention test was given to students after two weeks of the intervention. Four periods of forty minutes each was spent during the teaching. The difference between the activities of the experimental and control group follows;

Experimental group: The students in the experimental group were grouped heterogeneously in a group of six students per group based on their performance in



the pretest; the class was re-constructed in a semi-circular form to make it possible for proper learning and for the teacher to move across the groups. Each group selected their group leader, time keeper and recorder, in order to record what has been learnt in the group. The group leaders distributed the lesson modules among members during problem solving activities using the instructional guide on GLM as a stimulus for learning. After this, students’ brainstorm, consult textbooks on their own to generate or construct knowledge based on their prior knowledge. Each group discusses their answers to the whole class so as to share ideas among themselves and the teacher corrects learners’ misconception during teaching.

Control group: students in the control group were taught probability using the conventional method. The conventional method of teaching involves the chalk, chalkboard and talk method. Teacher deliver lesson directly by explaining the concepts to students along with sample problems. Students only take notes and ask questions when necessary, but they were not exposed to any special treatment. At the end of the teaching, students were given assignment from their textbook. The assignment was marked and

recorded after which posttest was administered to them. After two weeks of the posttest, retention test was administered to both groups. The retention test for both groups were marked, scored and recorded for analysis.

DATA ANALYSIS AND RESULTS

The data obtained were analyzed and hypotheses were tested at 0.05 significance level.

Research Question One: What is the difference in the mean retention scores of students taught probability using GLM and those taught using Conventional teaching method? Its corresponding hypothesis is “there is no significant difference in the mean retention scores of students in probability exposed to GLM and those taught using conventional teaching method”

An independent sample t-test analysis was done in respect to research question I and hypothesis I. The mean retention score of the experimental group was 42.67 as compared to that of the control group which has 36.42. The experimental group having a higher mean retention score implies that students in the experimental group were able to retain learnt materials than those in the control group. (See Table 1)

Table 1: t-test analysis of retention scores of students taught probability using GLM and those taught using conventional method

Group	N	Mean	SD	df	t – cal	t-crit	Remark
GLM	51	42.67	3.48	94	8.92	1.96	Significant
Conventional	45	36.42	3.54				

The findings from table 1 showed that the calculated t-value of 8.92 was greater than the critical t-value of 1.96. Hence, the null hypothesis which stated that there is no significant difference in the mean retention scores of students in probability exposed to GLM and those taught using conventional teaching method was rejected. This indicated that there was a significant difference in the

mean retention scores of students taught probability using GLM and those taught using conventional method. This finding was in favour of students exposed to GLM.

Research Question Two: Do male and female students mean retention scores differ when taught probability using GLM? It has a corresponding hypothesis which state that “there is no significant

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difference in the mean retention scores of male and female students taught probability using GLM”

The data obtained from the scoring of the retention test in the experimental group was analysed using independent *t*-

test. The average retention score of male was 33.50 while that of the female was 32.18. The implication of this is that male students retained more learning material than the female.

Table 2: *t*-test analysis of male and female students’ retention scores in probability when taught with GLM

Gender	N	Mean	SD	df	t-cal	t-crit	Remark
Male	24	33.50	3.20	49	1.03	2.04	NS
Female	27	32.18	3.30				

The result of the findings in table 2 indicated that the calculated *t*-value of 1.03 was lower than the critical *t*-value of 2.04. Therefore, the null hypothesis which stated that there is no significant difference in the mean retention scores of students taught probability using GLM based on gender was not rejected. With this, it is evident that there is no statistical significant difference in the mean retention scores of male and female students taught probability using GLM.

DISCUSSION

The major finding of this study was that the GLM was more effective in retaining probability concepts than conventional teaching method. This could be attributed to the basic characteristics of the GLM strategy as a learner-centered strategy where learners construct or generate their own cognitive meanings to learned materials, relate the newly learned materials to prior knowledge, perform activities that could facilitate cognitive processes such as identifying their conceptions, their own misconceptions and correcting such misconceptions identified through classroom interactions. These learner activities helped them to become drivers in their learning and not passive recipient of information from the teacher. Although the teacher lead and facilitate the conceptual understanding skills in students.

Also, the senior school two students exposed to GLM was also able to perform better in probability than those in the conventional group based on the kind of self-initiated and self-directed activities which they participated during class activities. This is evident from the finding, as learning becomes more concrete, real, and meaningful when learnt materials were retained in form of schema and students can recall and recognize them when needed. The findings of this study is in agreement with the result obtained by Cabe (2010), Ogunleye and Babajide (2011), Alma and Elfateh (2016) and Rahayu and Sugianto (2019) who found that GLM was effective in the teaching of sciences and mathematics related subjects. The GLM was quite different from that of the conventional teaching method where students were passive recipients of information, where teachers were actively given information and thereby dominating the lesson, which encouraged students to learn by rote and resort to forgetting of concepts learnt easily within a limited time.

The second finding in this study indicated that both male and female students retained learnt materials equally. This implies that the use of GLM was not gender biased and such can be used to bridge the gap of performance between male and female students. This finding is in agreement with Akanmu and Fajemidagba (2013) and Salman and Ameen (2014).

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The findings of this study will be useful to mathematics educators, cognitive researchers, Nigerian quality assurance and standard officers, Mathematics Teachers, Students and School management. It will also add to current researches that are aimed at improving students' performance and retention in probability and particularly mathematics.

CONCLUSION AND RECOMMENDATIONS

It can be concluded from the findings of this study that using GLM to teach mathematics and particularly probability could help students to retain learnt materials. If students can retain learnt material, their performance in such subject will improve. Based on this, it was recommended that teachers should lead and encourage students to construct their own knowledge from learnt materials; male and female students should be given equal opportunity in mathematics class to compete and collaborate with peers; Mathematics teachers in the modern world should encouraged mathematics students to construct their own ideas, identify their conceptions, and misconceptions and they should be allowed to correct their own misconceptions with little support from the teachers to increase their cognitive ability; mathematics teachers should give all opportunity to students to perform all tasks whether simple, complex, specific or general so as to construct their own knowledge, test and evaluate their initial knowledge for conceptual understanding.

However, in other to make more generalization on the effectiveness of generative learning model on students' cognitive processes and storage which account for performance and retention, further research could focus on students' learning style, ability level, designing instructional materials suitable for GLM, and using different research design aside from quasi experiment.

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