

Effects of Gagne's Instructional Strategy on ... Idris, I. O. & Rabiu, A. T. (2025)

Effects of Gagne's Instructional Strategy on Retention in Mathematics among Senior Secondary School Students in Kogi State, Nigeria

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Abstract

The study investigated effects of Gagne's instructional strategy (GIS) on retention in Mathematics among senior secondary school students in Kogi state, Nigeria. The research adopted quasi-experimental-control design involving pre-test, post-test and post post-test. The population consists of all SS II students totaling 20,835 students from three (3) senatorial districts in Kogi State. 300 SS II students (140 males and 160 females) were sampled from six intact arm of classes from six (6) schools (two each) in 3 senatorial districts in Kogi State using multi-stage cluster sampling technique. Mathematics Performance Test (MPT) was used as instrument for data collection with a reliability coefficient of 0.68 obtained using Pearson Product Moment Correlation Coefficient (PPMC). Two research questions were raised and two hypotheses were formulated and tested at 0.05 level of significance. The research questions were answered using mean and standard deviation while the hypotheses were tested using related sample t-test, and paired sample t-test respectively. The findings reveal that: there was significant difference between the post-test and post post-test mean retention scores of students taught mathematics concepts using GIS and there was also significant difference between the post-test, post post-test mean retention scores of male and female students taught mathematics concept using GIS. The study concluded that Gagne's instructional strategy has significant effect in improving student's retention ability as well as capable of improving male and female students' retention ability in mathematics. It was recommended among others that the three tiers of government federal, state and local governments through ministry of education should organize seminars and workshop to equip secondary school mathematics teachers on the use of Gagne's instructional strategy.

Keywords: Gagne's Instructional Strategy, Retention and Mathematics.

Introduction

The importance of Mathematics to modern culture of science and technology has been well recognized and accepted worldwide (Eguavon, 2012). According to Ukeje (1997) cited in Bashir, Abubakar and Garba (2016), the increasing importance and attention given to mathematics stem from the fact that without science there is no modern technology and without modern technology, there is no modern society. In other words, Mathematics is the precursor and queen of science and technology and indispensable single element in modern societal development. It is an acknowledge fact that mathematics knowledge is needed to make for effective learning and development of science concepts. Different Mathematical topics such as vectors, calculus, logarithms, arithmetic, rate, summation are applied to solve scientific problems. In physics, area as thermal physics, thermodynamics, quantum physics, electric field, wave, motion and sound require a sound mathematics knowledge for proper comprehension (Onwuka & Iweka, 2017). Chemist, Biologist, Medical doctor, Pharmacist, Engineer, Physicist and many more need the application of mathematical technique (Onwuka, 1985) cited in Ojo and Egbon (2017). The importance of mathematics to nation building has led the Federal Government of Nigeria to make mathematics a core subject to be offered by secondary school students in Nigeria as stipulated in the National Policy on Education (FRN, 2013). In addition, it is studied as a compulsory subject at both lower and upper basic education in Nigeria so that every school child will acquire appropriate basic mathematics knowledge. To crown it all, graduates of secondary school in Nigeria are required to pass mathematics at credit level in WAEC, NECO and their equivalence to gain admission into tertiary institution. It is worthwhile to develop retention ability of secondary school students in such important subject.



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Retention plays a major role in the understanding, comprehensibility and application of mathematical concepts. Akinsola and Popoola (2014) observed that students' performance in mathematics becomes poorer as the test items moved from those requiring ability to recall to those involving some understanding and problem solving. Retention has been described by Bichi (2017) as the ability to maintain and later recall information or knowledge gained after learning. Retention of concepts learnt assist in reflective thinking and the retained concepts could be used (Ochonnoger,1997) as quoted by (Alice, 2017). Eze and Bot (2018) observes that learning outcome is influenced by the instructional strategy employed by teacher; it is the only factor that can easily be maneuver by teacher to achieve learning objectives. It is an acknowledged fact that the mathematics classroom in senior secondary schools in Nigeria has been associated with conventional teaching method, a teachers-centered approach which does not involve students in an active learning and does not promote insightful learning and long-term retention of some abstract concepts. It has been characterized as lecture-based method because it emphasizes passive acquisition of knowledge in such a way that students become passive learners of knowledge which promotes rote learning (Okoli, 2008). However, the National Policy on Education stipulated that education activities shall be learner centered for maximum self-development and self-fulfillment. The need to devise alternative effective instructional strategy that work in line with the desire of this policy is the purpose of this study. The researcher therefore, seeks to examined if Gagne Instructional Strategy could be an alternative effective instructional strategy that can improve the retention ability of secondary school students in mathematics.

Gagne's Instructional Strategy (GIS) is a student's-centered approach developed for planning the teaching process in computer and internet-based program. It is a technology intensive process and the model is a synthesis behavior and cognitive psychology. It is based on the information processing model of the mental events that occur when learners are presented with various stimuli and focuses on the learning outcomes and how to arrange specific instructional events to achieve those outcomes. Instructions may be conceived as a deliberately arranged set of external events designed to support internal learning process and retention. Gagne's theory of instruction is perhaps a clearer demonstration of a comprehensive instructional theory. The events of instruction according to Gagne et al (2005) cited in Effiom (2024) refers to methods or procedures designed to facilitate the specific processes (such as encoding, retention, retrieval and so on) thought to occur during learning. Gagne's Instructional Strategy involve nine activities namely Gaining attention, informing the learner of the objective, stimulating recall of prior learning, presenting the stimulus, providing learning guidance, eliciting performance, providing feedback, assessing performance and enhancing retention and transfer (Effiom, 2024). Khadjooi, Rostami and Ishaq (2011) posited that the Strategy provides framework for designing effective instruction by outlining a sequence of events that enhance learning and promote retention of knowledge and skills which generally improve students' performance and retention. The most significant outcome of using GIS is that, students retain their learnt concepts and are better problem solvers when working alone after being part of a group. This could be a clear inference that GIS is a valuable tool in a teacher's arsenal that can enhance students' problem-solving ability and their retention (Tang et al., 2020). The study conducted by Adanyi (2019); Alhaji and Abdullahi (2023) revealed that there was significant difference between the Posttest and Post-posttest mean retention scores of students in experimental group treated with Gagne's Instructional Strategy and similarly, students on gender basis. But contrary results was obtained by Agboghroma, Job and Akpakiniov (2022) whose study pointed out that there was no significant difference between the Posttest and Post-posttest mean retention score of students exposed to Gagne's Instructional Strategy and also students on gender basis. The researcher therefore, determined the impact of Gagne's Instructional Strategy on Retention Ability in Mathematics among Senior Secondary School Students in Kogi State Nigeria.

Performance in Mathematics at the Nigerian secondary school level in WASSCE has improved for the past few years as per the WAEC Chief Examiner's Report (2022, 2023, and 2024) based on the statistics of students with A's, B's, and C's. With this development in terms of performance, more is needed to be done to maintain the tempo. Again, this does not mean that success has been attained in teaching mathematics as there are lots of factors that still militate against the teaching and learning of mathematics at the secondary school level that must be addressed, among which is instructional strategy used by mathematics teachers. Eze and Bot (2018) observes that learning outcome is influenced by the instructional strategy employed by teacher; it is the only factor that can easily be maneuver by teacher to achieve learning objectives. It is an acknowledged fact that the mathematics classroom in senior secondary schools in Nigeria has been associated with conventional teaching method, a teachers-centered approach which does not involve students in an active learning and does not promote insightful learning and long-term retention of some abstract concepts. It has been characterized as lecture-based method because it emphasizes passive acquisition of knowledge in such a way that students become passive learners of knowledge which promotes rote learning. However, the National Policy on Education (2013) stipulated that education activities shall be learner centered for maximum self-development and self-fulfillment. The need to devise alternative effective instructional strategy that work in line with the



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Objectives of the Study

The objectives of this study are to:

1. Investigate the effects of Gagne’s Instructional Strategy on retention ability of senior secondary school students’ in Mathematics.
2. Find out the effect of Gagne’s Instructional Strategy on the retention ability of male and female senior secondary school students in Mathematics.

Research Questions

The following questions were raised to guide the study:

1. What is the difference between the post-test and post post-test retention mean score of students taught Mathematics concepts using Gagne’s Instructional Strategy?
2. What is the difference between the post-test and post post-test retention mean score of male and female students taught Mathematics concepts using Gagne’s Instructional Strategy?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

Ho₁: There is no significant difference between the post-test and post post-test retention mean score of students taught Mathematics concepts using Gagne’s Instructional Strategy.

Ho₂: There is no significant difference between the post-test and post post-test retention mean score of male and female students taught Mathematics concepts using Gagne’s Instructional Strategy.

Methodology

The study employed a quasi-experimental research design involving pre-test, posttest and post post-test. The design was adopted because it is not possible to have a complete randomization of the subjects as this would disrupt school organization. Samples of 300 (SS11) Students were selected from a population of 20,835 (SS11) Students within Kogi State. The sample consists of 160 students (76 males and 84 females) in the Control Group (CG) and 140 students (62 males and 78 females) in the Experimental Group (EG). Multistage Cluster Sampling Technique was used to select sample for the study. This involved six intact arms of classes from six schools (two from each senatorial district) randomly selected from the three senatorial districts in Kogi State. Mathematics Performance Test (MPT) was developed for Pretest, Posttest and Post-Posttest. It contained 20 items and multi-choice Format with option a-d. The instrument was validated and the reliability coefficient using Pearson Product Moment Correlation Coefficient (PPMCC) was computed to be 0.69. The students in both CG and EG were given MPT to test the equity of their ability levels followed by a treatment for five (5) weeks with CG students taught with conventional method and EG students taught using Gagne’s Instructional Strategy. At the end of the treatment, Post-test was administered to the two groups and a reshuffle MPT was administered after two weeks to the EG students only, to determine retention ability. Descriptive statistics (mean and standard deviation) were used to analyze collected data to answer the research questions and inferential statistics Related Sample t-test and Paired Sample t-test were used to analyze data to test the formulated null hypothesis Ho₁ and Ho₂ respectively at 0.05 level of significance. This is because the data collected in respect of them were interval data.

Presentation of Results

The data obtained from the study were analyzed using version 23.0 of the Statistical Packages for Social Sciences (SPSS) as follow:

1. What is the difference between the post-test and post-posttest retention ability mean score of students taught mathematics concepts using Gagne’s Instructional Strategy?

Table 1: Summary of Retention Mean Scores and Standard Deviation of Students in Post-test and Post-posttest

Variable	Test	N	Mean	SD	Mean Difference
Retention	Post-test	140	48.96	6.98	7.39
	Post-posttest	140	56.35	5.25	



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Analysis in Table 1 revealed that the Post-test and Post-posttest mean score of students are 48.96 and 56.35 with standard deviation 6.98 and 5.25 respectively and a difference of 7.39 in favour of post-Posttest. In order to establish if the difference between the Post-test and Post-posttest mean score is statistically significant, inferential statistics was used to test the formulated null hypothesis as presented in Table 3.

2. What is the difference between Post-test and Post-posttest Retention mean score of Male and Female Students taught Mathematics Concepts using Gagne’s Instructional Strategy?

Table 2: Summary of Retention Mean Scores and Standard Deviation of Male and Female Students in Post-test and Post-posttest

Variable	Gender	Test	N	Mean	SD	Mean Difference
Retention	Male	Post-test	62	49.19	6.54	7.82
		Post-posttest	62	57.01	5.13	
	Female	Post-test	78	49.09	6.28	8.03
		Post-posttest	78	57.12	5.01	

Analysis in Table 2 revealed that the Post-test and Post-posttest mean score of male students are 49.19 and 57.01 with standard deviation 6.54 and 5.13 respectively and a difference of 7.82 in favour of post-Posttest. Result occurred in the same manner for Post-test and Post-posttest mean score of female students which are 49.09 and 57.12 with standard deviation 6.28 and 5.01 respectively and a difference of 8.03 in favour of post-Posttest. In order to establish if the difference between the Post-test and Post-posttest mean score are statistically significant, inferential statistics was used to test the formulated null hypothesis.

Testing the Hypotheses

Ho₁: There is no significant difference between post-test and post post-test retention mean score of students taught mathematics concepts using Gagne’s Instructional Strategy.

To test the formulated null hypothesis, related sample t-test was used to analyze the collected data as presented in Tables 3.

Table 3: Summary of Related Sample t-test on the Significant Differences between the Post-test and Post-posttest Mean Retention Score in Experimental Group.

Variable	Test	N	Mean (\bar{x})	SD	df	t-value	P-value	Remark
Retention	Post-test	140	48.96	6.98	139	4.86	.002	*
	Post-posttest	140	56.35	5.25				

* Significant at $P \leq 0.05$ level of significance

The result in Table 3 showed significant difference $P = 0.002 < 0.05$ level of significance. The null hypothesis was therefore rejected. This implies that there is significant difference between the Post-test and Post-posttest retention mean scores of students taught mathematics concepts using Gagne’s Instructional Strategy.

Ho₂: There is no significant difference between post-test and post post-test retention mean score of male and female students taught mathematics concepts using Gagne’s Instructional Strategy.

To test the formulated null hypothesis, Paired sample t-test was used to analyze the collected data as presented in Tables 4.

Table 4: Summary of Paired Sample t-test Statistics on the difference between Post-test and Post-Posttest Mean Retention Scores of Male Students in the Experimental Group.

Gender	Test	N	Mean (\bar{x})	SD	df	t-value	P-value	Remark
Male	Post-test	62	49.19	6.54	61	4.17	.003	*
	Post-posttest	62	57.01	5.13				
Female	Post-test	78	49.09	6.28	77	3.98	.015	*
	Post-posttest	78	57.12	5.01				

* Significant at $P \leq 0.05$ level of significance

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The result in Table 4 showed significant differences: $P = 0.003 < 0.05$ and $P = 0.015 < 0.05$ respectively. The null hypothesis was therefore rejected. This implies that there is significant difference between the Post-test and Post-posttest retention mean scores of males and students taught mathematics concepts using Gagne's Instructional Strategy.

Discussion of Findings

The related sample t-test analysis in Table 2 showed significant differences between the Post-test and Post-posttest mean score of students in experimental group exposed to Gagne's Instructional Strategy as treatment in favour of post-posttest. This implies that the P value was less than 0.05 alpha level. This result provide support for the capability of the strategy in bringing about improved students' retention ability in mathematics. This result supports the findings of Adanyi (2019) who lamented that of Gagne's Instructional Strategy (GIS) enhances students' retention ability in mathematics but it contradicted that of Agboghroma, Job and Akpakiniovo (2022) which showed that Gagne's Instructional Strategy was not effective in increasing students' retention ability. The paired Sample t-test analysis in Table 4 showed significant differences between the Post-test and Post-posttest mean score of male and female students in experimental group exposed to GIS treatment in favour of post-posttest, meaning that in each sex, the P value was less than 0.05 alpha level. This result provide support for the capability of the GIS in bringing about improved male and female students' retention ability in mathematics. The result, though not in conformity with the finding of Agboghroma, Job and Akpakiniovo (2022) but agreed with the result of the study of Alhaji and Abdullahi (2023) who discovered that both male and female students taught with Gagne's Instructional Strategy significantly increased their mean retention scores in Post-posttest over the Post-test.

Conclusion

Based on the findings of this study, it was concluded that Gagne's instructional strategy has significant effect in improving student's retention ability as well as capable of improving male and female students' retention ability in mathematics.

Recommendations

The following recommendations were made base on the findings from the study:

1. Gagne's instructional Strategy is capable of improving retention ability in mathematics base on the result of the study. Hence, the three tiers of government: federal, state and local governments through ministry of education should organize seminars and workshop training to equip secondary school mathematics teachers on the use of Gagne's instructional strategy.
2. Teacher training institutions such as Universities and Colleges of education that train secondary school mathematics teachers should incorporate the use of Gagne's instructional strategy part of their mathematics teacher education curriculum to promote the teaching of mathematics as it enhances students' retention as well as students on gender bases.

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