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EFFECTS OF MERRILL'S FIRST PRINCIPLES, GAGNE'S NINE-EVENT INSTRUCTIONAL MODELS AND LECTURE METHOD ON MATHEMATICS STUDENTS' ACHIEVEMENT IN DELTA STATE

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ABSTRACT

The purpose of the study was to determine the effects of Merrill's first principles of instruction, Gagne's nine-event Instructional strategy and Lecture method on students' achievement scores. For the study, three research questions were raised and three hypotheses formulated. The study adopted a 3×2×2 factorial planned variations quasi-experimental design. The design consisted of three instructional models (Merrill's first principles of instruction, Gagne's nine-event instructional models, and lecture method), sex (male and female) and repeated testing (Pre-test and post-test). The variables for the study included: Merrill's first principles of instruction, Gagne's nine-event instructional models, and lecture method as independent variables, achievement scores as dependent variables and sex as intervening variables. The sample for the study consisted of 318 students from six secondary schools sampled from schools in Delta State. The instrument for data collection was the Mathematics Achievement Test (MAT). The instrument was properly validated and reliability determined before it was used. A reliability coefficient value of 0.82 was obtained after data collected was analyzed using Kuder-Richardson formula 21. Data collected for the study were analyzed using descriptive statistics of the mean, standard deviation and the hypotheses were tested using inferential statistics of independent sample t-test, ANOVA and ANCOVA. All hypotheses were tested at 0.05 alpha level of significance. The findings of the study included the following: (i) a significant difference in the mean achievement scores of Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method (ii) no significant difference in the mean achievement test scores of male and female Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method (ii) no significant interaction effect between methods and sex on mathematics students achievement. As a result of the findings, it was concluded that Merrill's first principles, Gagne's nine-event Instructional Models are more effective in teaching mathematics when compared with lecture method and it is recommended that teachers and students should be properly trained to acquire the skills on usage of Merrill's first principles of instruction and Gagne's nine-events of instruction model and be encouraged to apply them when teaching and learning mathematics.

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

KEYWORDS: Principle, instruction, instructional strategy, Merrill's First Principles, Gagne's Nine-Event Instructional Models, and achievement

INTRODUCTION

Mathematics education is the foundation of science and technology, without which no nation can ever be prosperous and economically independent (Suleiman and Sada, 2022). In their opinion also, the knowledge of mathematics facilitates the knowledge of other fields of study to stimulate national development. Earlier on, Anaduaka and Okafor (2013) had stated that there are lots of evidences to show that nations that embrace mathematics, science and technology enjoy a better standard of living and that they are less dependent on others. One of the objectives of mathematics education is to impart knowledge that reflects its beauty with all rigors and also to give an experience of its strength to support the development in other sphere of human knowledge and to solve predicting problems (Odo, 2016). Going further, Odo (2016) asserted, that the knowledge of mathematics has helped in the development of modern technology by applying its principles in modern innovations. From his assertion, it can be said that the goals of economic and technological development of a country can be effectively achieved if mathematics is given priority in the school curriculum. No wonder mathematics is made a compulsory subject at the basic and senior secondary school levels of education in Nigeria. The policy decision which made the study of mathematics a compulsory core subject is contained in the National Policy on Education (FRN, 2013). The decision for making mathematics a core subject is based on its importance in various fields of science and technology. This implies that the knowledge of mathematics is essential for all members of the society. Also, proficiency in mathematics is a requirement to be obtained for any course of study in higher institutions of learning. For one to be successful in life, one need to acquire the basic mathematical knowledge needed in one's chosen career or vocation. With this, one can say that mathematics is the foundation of all subjects and vocations.

Despite the importance of mathematics, it has been observed that students perform poorly in mathematics both in internal and in external examinations. Over the years, examination bodies specifically, Basic Education Certificate Examination Chief Examiner's Reports (BECE), (2019- 2022) reported that the inability of students to solve problems on simplifying equation, label Venn diagrams, solve problems on sets, find angle in a triangle, find equation of a line and find median from frequency tables. All these weaknesses are responsible for the downward trend in the performance of students in mathematics. To buttress this fact, Odili, (2014) observed that students lack interest in the subject and perform poorly. This has been blamed on teachers teaching methods. Okori and Alazor (2020) stated that students' performance is greatly dependent on the strategy adopted by the teacher.

Experience and Observation have shown that mathematics which requires the use of critical skills and active participation of students is taught using lecture method. Lecture method is a methodology that makes the teacher a sole dispenser of knowledge instead of someone who guides the students in the teaching learning process. The use of lecture method makes students to be passive. This methodology also encourages students to learn through rote and memorization process. When students memorise,

concepts taught, they tend to forget what have been learnt easily since the concepts learnt is stored in their short-term memory. The usage of lecture method can be said to be an inefficient way of engaging students with academic knowledge, because the use of the method does not provide adequate learning experience and this leads to poor achievement. To solve this problem, there is need to reverse the trend from the traditional teaching methods (predominantly lecture method) to a more efficacious strategy that will enable students participate in the teaching and learning process. Some of the models that seem to have the characteristics for students' active participation in the classroom is the Merrill's first principles of instruction and Gagne's nine-event instructional models.

Merrill's First Principles of Instruction (MPI) is an instructional design framework developed by David Merrill in 2002. The principle provides guidelines and principles for creating effective and learner-centered instructional experiences. It aims to promote meaningful engagement of learners in the teaching learning process and it is recognized for focusing on maximizing knowledge from learning experience. MPI consist of five learning principles which are: Task-centred. Activation, Demonstration, Application, and Integration. At the task centred stage, emphasis is placed on designing authentic real-world problems that learners are likely to encounter. This stage promotes the active engagement of learners in problem-solving activities and this fosters their critical thinking and problem-solving skills. At the activation stage the principle is focused on engaging learner's prior knowledge and their experiences thereby, creating a foundation for new learning. To achieve this, learners' curiosity is stimulated by presenting real-world examples, and connecting new information to their existing knowledge. The demonstration stage lays emphasise on providing clear models or examples which illustrate the desired learning outcomes. Learners observe demonstrations to develop an understanding of how to perform the desired tasks.

After the demonstration principle, comes the application principle. This principle put emphasis on providing opportunities for learners to practice and apply their knowledge and skills in authentic contexts. This involves designing activities that require learners to actively apply what they have learnt in solving problems, making decisions, and engaging in realistic tasks. The last is the integration principle which focuses on promoting the transfer of knowledge and skills to new situations. With this principle, opportunities are provided for learners to enable them connect their learning to real-world contexts and apply it in meaningful ways. Integration can be achieved by presenting complex and authentic problems or scenarios that require learners to apply their learning in novel ways.

These five key principles form the foundation of Merrill's First principles of instructional design approach. They are designed to create meaningful, engaging, and transferable learning experiences for learners. Merrill believed that effective learning experiences are rooted in problem-solving. These principles deliver value because learners' who are exposed to them, know how to apply what they have learnt.

Another model that has the ability to foster active participation is the Gagne's nine-event of instructional models. The Gagne's nine-event instructional model has nine steps: Gaining attention,

informing learner of the objective(s), Stimulate recall of prior learning. Presenting the content, elicit performance, providing feedback about performance, assess performance, and E=enhance retention and transfer. In Step 1 which is the Gaining attention, to gain students attention, the teacher asks students what they know about the concepts to be studied. Students are asked to explain the concept to be studied. The aim of this is to determine their prior knowledge about the concept to be taught. In Step II which is Informing learner of the objective(s). Students are informed of the objectives to be achieved at the end of the lesson. In Step III which is Stimulating recall of prerequisite learning, Students are asked to solve related problems to the concepts to be studied and with that idea gotten, they are made to solve the main concepts. It is expected that these activities will lead to conceptual understanding. The aim is to encourage participation. Step IV: which is presenting the stimulus material, engages students in activities that are related to the concepts to be studied. The aim is to encourage participation. In Step V which is providing learning guidance, students are guided to bring out a problem that they will solve. The aim is to encourage participation and critical thinking. Step VI which is Eliciting the performance, involves the teacher going round to see if students' workings are correct. The aim is to encourage participation and foster understanding. Step VII is providing feedback about performance. In this step teacher corrects the students based on what he/she discovered in step VI. The aim is to foster understanding. While Step VIII. is assessing performance. Learners are made to solve more of the problems with feedback, the aim is to activate retrieval and make reinforcement possible. This will be done by providing students with homework and class work from the textbooks. The work is assessed and feed-back provided. Step IX which is enhancing transfer/ drawing of conclusion, involves the teacher explaining all the necessary procedures required in solving the problems and putting into consideration all the mistakes made by learners at all the other stages. Also the teacher asks the student to relate what they have learnt to what is happening in their environment. The aim is to provide varied practice and promote understanding. In order to draw conclusion, the teacher explain the concepts taught putting into consideration students' assumptions and misconceptions. Teachers ask questions, answers students 'questions to ascertain students understanding and summarizes the lessons.

The effectiveness of any model or instructional strategy is reflected in students' achievement irrespective of sex. Achievement in mathematics refers to the knowledge gained by students which is reflected in the scores that they obtain after a test or an examination in mathematics. When students are outstanding in their performances, it shows that they have learnt well in the teaching and learning process irrespective of their sex. Sex is a state of being a male or a female. The mathematics classroom is made up of students that are either males or females. These students irrespective of their sexes are exposed to same conditions of teaching and learning so it becomes necessary to use methods/strategies that are not gender biased to teach mathematics.

Since the Merrill's first principles of instruction and Gagne's nine-event instructional models shares common elements by emphasizing the importance of activating prior knowledge and providing opportunities for practice to students in the learning process, it becomes important to use them in

teaching mathematics. Although both have their differences for instance, Merrill's first principles places strong emphases on strong task-centered, problem-solving instruction while Gagne's model outlines a more structured sequence of instructional events aimed at promoting effective learning. Both strategies offer valuable insights and guidance and both have the characteristics of making students effectively participate in the teaching - learning process. The use of both strategies has been found to positively influence students' performance. It is against this background that this study is aimed at finding out which of the two methods will be the best for teaching and learning mathematics and also in comparison with lecture method.

STATEMENT OF PROBLEM

The study emanated from three problems as follow: a call for the use of learner centred method of teaching, the persistent poor performance of students, and a dearth of literature on the usage of Merrill's first principles and Gagne's nine event instructional model in the teaching of mathematics in Delta State. Over the years, examination bodies specifically, Basic Education Certificate Examination (BECE) Chief Examiners Reports (2019-2022), have been reporting weakness on answers to questions given by students which are responsible for the downward trend in the performance of students in mathematics. Also research findings have shown poor performance of students in mathematics at the junior secondary school level. This situation has been blamed on teachers' predominant use of the lecture method. To buttress this fact, literature over the years has shown that mathematics is one of the subjects that are most poorly taught and widely hated by students in schools, and that this affects students' achievement in mathematics in the Basic Education Certificate Examination. To solve this problem, researchers through various studies found that student's performances in mathematics could be improved through the use of students' centred methods in the teaching- learning process. The studies noted that instructional methods for teaching mathematics should be those which have the ability to stimulate student's interest by reducing the abstractness of the subject. This, therefore, calls for the need to reverse the trend from the traditional methods of teaching to more efficacious strategies. Based on this, the statement of the problem of the study is "what effects will the use of Merrill's First principles of instruction, Gagne's nine-event instructional models and Lecture method have on students' achievement in mathematics?

RESEARCH QUESTION

1. What is the difference in the mean achievement test scores of Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method**?**
2. What is the difference in the mean achievement test scores of\ male and female Mathematics Students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method?
3. What is the effect of interaction between sex and methods on mathematics student's achievement?

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

Hypotheses

$H0_1$: There is no significant difference in mean achievement test scores of Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Model and Lecture Method

$H0_2$: There is no significant difference in the mean achievement test scores of male and female Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method

$H0_3$: There is no significant difference in the mean achievement test scores of male and female Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method

RESEARCH DESIGN

The design adopted for this study was the planned variation quasi-experimental 3×2×2 factorial design. The design consisted of three instructional models (Merrill's first principles of instruction, Gagne's nine-event instructional model and lecture method), sex (male and female) and repeated testing (Pre-test and post-test), In this design, there was no randomization of subjects into groups but rather, intact classes were used. The variables for the study were Instructional strategies- Merrill's first principles of instruction, Gagne's nine-event instructional models and lecture method (independent variable), achievement, (dependent variables), and sex (intervening variable). This design was considered appropriate because it was not practicable to randomly assign subjects into groups and as such, intact classes were used. According to Johnson and Christensen (2000), any design in which randomization is a condition for true experimental design is omitted, such design is described as quasi-experimental design.

STUDY POPULATION AND SAMPLE

The population for the study consisted of all mixed public Junior Secondary Class 11 mathematics students in Delta State. There are four hundred and seventy-one schools (471), one hundred and eighty-seven (187) in Delta Central, one hundred and sixty-eight (168) in Delta North and one hundred and sixteen (166) in Delta South, and fifty thousand, five hundred and twenty-five (50,525) students in Delta state (Delta State Ministry of Basic and Secondary Education, 2022). Only public schools were used because they all have almost the same learning environment and they are governed by a central body which is the Post-Primary Education Board.The sample for the study consisted of 318 students sampled from six mixed junior secondary schools randomly selected from the three senatorial Districts. Two schools each were selected from each of the senatorial Districts. Six junior secondary schools, six mathematics teachers and six intact classes make up the sample for the study. The sampling technique that was used in the selection of schools and classes was the simple random sampling technique (Balloting) using withdrawal with replacement strategy. In doing this, all the mixed junior secondary schools in the senatorial districts were listed. The names of the schools were written on pieces of paper, folded and put into a blind bag. Using withdrawal with replacement method of balloting, the required number of schools was selected.

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

INSTRUMENTS AND MATERIALS

The instrument for data collection is the mathematics achievement test (MAT). It is made up of two sections. Section A contains questions asked on students' bio-data, while section B contains 50 items, drawn from fractions and percentages. The items on section B were generated from past BECE question papers by the researcher. The questions in Section B were multiple choices of one correct answer with four distractors. Each question in section B required one answer to be chosen by respondents. The mathematics achievement test instrument (MAT) was administered to students for pre-testing and post testing to generate data for achievement scores.

The intervention packages are the Merrill's First Principles of Instruction and Gagne's Nine-Event Instructional Model Packages. Merrill's First Principles of Instruction package contains two sections, Section A deals on the concept of Merrill's principles and the basic steps to be followed in teaching using Merrill's first principles of instruction in the classroom. while section B contains lesson plan on the usage of Merrill's first principles of instructional model Package. The Gagne's Nine-Event Instructional Model has two sections. Section A deals with the concept of Gagne's nine-event instructional model and the basic steps to be followed in teaching, using Gagne's nine-event instructional model in the classroom, while the section B contains the various activities to be carried out by the teachers and students in teaching with Gagne's nine-event instructional model, as shown in section B.

Validation of Instrument

Two validity measures were conducted on the instrument MAT (face and content). For the MAT, the face validity of the instrument was determined by three experts: one expert in science education, one expert in mathematics and one expert in measurement and evaluation. They specifically looked at the Mathematics Achievement Test (MAT) questions, the research questions and the hypotheses with the aim of establishing if the instrument could give the needed data to answer the research questions and test the hypotheses. They suggested that two items should be reframed and this was effected after which it was approved for data collection. The content validity was done using a table of specifications based on Blooms taxonomy to ensure that the concepts were rightly covered.

Reliability of Instruments

In determining the reliability of the instrument (MAT), the instrument was administered to twenty JS II students in school in Ovia North senatorial district in Edo State who were not part of the sample used for the study. Data collected were analyzed using Kuder-Richardson Formula 21 to determine the reliability value. The formula was used because the instrument was an achievement test with one mark for correct answer and zero for wrong answer. From the analysis of the data collected, an r-value of 0.82 was obtained for the achievement test.

Treatment Procedure

(a) Training of Research Assistants

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

Research assistants were trained for three days on the step-by-step procedure of using Merrill's first principles of instruction and the Gagne's nine model of instruction in the classroom, by the researcher using instructional packages while the lecture method group teachers were left to use their normal steps n teaching

(b). Pre-testing of the Groups

A week before the commencement of the treatment, the students that were in the Merrill's first principles of instruction group and the Gagne's nine-event instructional group were pre-tested using mathematics achievement test. The completed mathematics achievement test was collected from the students after one hour, scored and recorded as pre-test. The pre-test scores were used to determine the equivalence of the groups. Immediately after the pretest, the investigator distributed the plans on the usage of the instructional models to the teachers (research assistants). They were instructed to follow the guidelines strictly in the application of the recommended instructional methods in their respective classes.

Post-testing

At the end of the treatment which lasted for six weeks, the researcher administered another copy of the Mathematics Achievement Test as post-test on both the Merrill's First principles of instruction model , Gagne's nine-event instructional and lecture group students as post-test.

Method of Data Analysis

To analyze the data collected, Research questions 1-3 were answered using descriptive statistics of the mean and standard deviation, while the hypotheses were tested using Analysis of Variance, Analysis of Covariance and independent sample t-test statistics

RESULTS

Research Questions one: What is the difference in the mean achievement test scores of Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method**?**

To answer the research question descriptive statistics of the mean and standard deviation were used to compare the post achievement scores of the students' in the three groups and the result is shown in Table 2.

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

Table 1: Descriptive statistics of mean and standard deviations showing the difference in the achievement among mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method at Post-test

Groups	N	Mean	SD
Merrill's	135	59.82	12.88
Gagne's	101	57.96	11.51
Lecture	82	54.30	14.31

Table 1 shows that at posttest, the Merrill's first principle of instruction group had a mean of 59.82 with a standard deviation of 12.88. For the Gagne's nine-events of instruction group, the students had a mean score of 57.96 with a standard deviation of 11.51, Lastly, the lecture method group had a mean of 54.30 with a standard deviation of 14.31. There exists a mean difference among the mean scores of the three group students. To determine if the difference is significant, Analysis of Co-Variance statistics (ANCOVA) was used to test $H_{01,}$ as shown in Table 3.

Hypothesis one: There is no significant difference in the mean achievement test scores among Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method.

In order to determine the appropriate statistics to be used to test $H0_2$, Analysis of Variance (ANOVA) Statistics was used to test their pre-test scores and the result is shown in Table 2.

Table 2: ANOVA Statistics comparing the post achievement scores of students taught with Merrill's first principles, Gagne's nine-event Instructional Model and Lecture Method at pre-test

	Sum of Square	df	Mean Square	F	Sig
Between Groups	865.811	2	432.905		
				4.485	0.012
Within Groups	30402.520	315	96.5		
Total	31268.330	317			

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

Table 2 shows that the difference is significant at pre-test since the cal. significant value of 0.012 which is less than 0.05 was obtained; therefore, Analysis of Covariance (ANCOVA) becomes the appropriate statistics to be used to test hypotheses 2 as shown in Table 3

Table 3: ANCOVA Statistics comparing the post achievement scores of students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method at post-test.

Source	Type 111 Sum Of Square	`	df	Mean Square	F	Sig
Corrected Model	6464.208		3	2154.736	14.348	0.000
Intercept	48285.533		1	48285.533	321.518	0.000
Pre-test	4903.830		1	4903.830	32.653	0.000
Group	2084.940		2	1042.470	6.941	0.001
Error	47156.471		314	150.180		
Total	1116424.000	318				
Corrected Total	53620.679		317			

Table 3 shows that the difference is significant at post-test since the calculated significant value of 0.001 is less than 0.05 alpha level of significance, therefore $H0_1$ which states that there is no significant difference in the mean achievement test scores of mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method was rejected.

In order to determine the direction of the significance a Post Hoc analysis was carried out using Bonferroni test and the result is shown in table 4a.

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

Table 4a: Bonferroni test showing the direction of significance in the achievement of mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method

Group (I)	Group (J)	Mean Difference I-J	Std. Error	Sig
Merrill's	Gagne	0.809	1.623	1.000
	Lecture	6.179	1.720	0.001
Gagne	Merrill's	-0.809	1.623	1.000
	Lecture	5.370	1.846	0.012
Lecture	Merrill's	-6.179	1.720	0.001
	Gagne	-5.370	1.846	0.012

Table 4a shows that the directions of the difference are between Merrill's first principle of instruction (P= 0.001) lecture method group. The significant difference is in favour of Merrill's first principle of instruction whose students had a mean score of 57.96 which is greater than a mean score of 54.30 obtained by the lecture group students. The second direction of the significant is between Lecture method and Gagne's nine-event of instructional model (P= 0.012). The significant difference is in favour of Gagne's nine-event instructional model whose students had a mean score of 59.92 which is greater than a mean score of 54.30 obtained by the lecture group students.

Research Questions two: What is the difference in the mean achievement test scores of male and female Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Model and Lecture Method**?**

To answer the research question descriptive statistics of the mean and standard deviation was used to compare the post achievement scores of the male and female mathematics students in the three groups and the result is shown in Table 5

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

Table 5: Descriptive statistics of mean and standard deviation showing the difference in the mean achievement scores of male and female mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method on Mathematics Students achievement scores at Post-test

Groups	Sex	N	Mean	Mean Diff.	SD
Merrill's	**Male**	58	61.33		14.22
				2.63	
	female	77	58.70		11.74
Gagne's	**Male**	37	59.78		14.99
				0.14	
	Female	64	59.92		8.87
Lecture	**Male**	31	58.03		16.75
				5.99	
	Female	51	52.04		12.23

Table 5 shows that at posttest, male students taught with Merrill's first principle of instruction group had a mean score of 61.33, with a standard deviation of 14.22, and their female counterparts had a mean score of 58.70 with a standard deviation of 11.74. The mean difference between the two sets of scores was 2.63, in favour of the male students. For the Gagne's nine -events of instruction group, the male students had a mean score of 59.78, with a standard deviation of 14.99 and a mean of 59.92 with a standard deviation of 8.87 for the female students. The mean difference between the two sets of scores was 0.14, in favour of the female students. Lastly, in the lecture methodgroup, the male students had a mean score of 58.03 with a standard deviation of 16.75, and a mean score of 52.04 with a standard deviation of 12.23 for the females. The mean difference between the two sets of scores was 5.99, in favour of their male counterparts. To determine if the difference was significant, independent sample t-test statistics was used to test $H0_4$, as shown in Table 6.

Hypothesis two: There is no significant difference in the mean achievement test scores of male and female Mathematics Students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method**.**

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

In order to determine the appropriate statistics to be used to test $H0_4$, independent sample t-test Statistics was used to test their pre-test scores

Table 6: Independent Sample t-t statistics comparing the effects Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method on male and female Mathematics Students achievement scores at Pre-test

Groups	Sex	N	Mean	Mean Diff.	SD	df	tcal	Sig(2-tail)
Merrill's	**Male**	58	34.40		9.07			
			1.14		133	0.677		0.499
	Female	77	32.30		10.06			
Ganges	**Male**	37	31.35		8.15			
			0.95		99	0.181		0.859
	Female 64	30.40		11.21				
Lecture	**Male**	31	31.06		7.51			
			1.51		80	0.226		0.820
	Female 51	32.57		10.91				

Table 6 shows that the difference was not significant at pre-test, therefore independent sample t-test statistics became the appropriate statistics to be used to test $H0_2$, and the result is shown in Table 7.

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

Table 7: Independent Sample t-t statistics comparing the difference in the mean achievement scores of male and female mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method on Mathematics Students achievement scores at Post-test

Groups	Sex	N	Mean	Mean Diff.	SD	df	tcal	Sig (2-tail)
Merrill's		**Male**	58	61.33		14.22		
				2.63		133	1.174	0.242
	female	77	58.70		11.74			
Ganges		**Male**	37	59.78		14.99		
				0.14		99	1.196	0.235
	Female		64	59.92		8.87		
Lecture		**Male**	31	58.03		16.75		
				5.99		80	1.867	0.066
	Female		**5**1	52.04		12.23		

Table 7 shows that the difference is not significant at post-test for the Merrill's first principle of instruction, Gagne's nine- event instructional groups and Lecture method group since the calculated sig values of 0.241, 0.235 and 0. 066 obtained are greater than the alpha value of 0.05, therefore $H0_2$ which states that there is no significant difference in the mean achievement test scores of male and female Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method was not rejected.

Research Question Three: What is the effect of interaction between sex and Methods on mathematics students' achievement?

To answer the research questions descriptive statistics of the mean and standard deviation were used to compare the post achievement scores of the students' in the three groups and the result is shown in Table 8

International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

Table 8: Descriptive statistics of mean and standard deviations showing the mean interaction effect scores of mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method

Groups	Sex	N	Mean	Mean Diff	SD
Merrill's		135	59.82		12.88
Ganges		101	57.96		11.51
Lecture		82	54.30		14.31
Merrill's	**Male**	58	61.33		14.22
				2.63	
	female	77	58.70		11.74
Ganges	**Male**	37	59.78		14.99
				0.14	
	Female	64	59.92		8.87
Lecture	**Male**	31	58.03		16.75
				5.99	
	Female	51	52.04		12.23

Table 8 shows that at posttest, the Merrill's first principle of instruction group had a mean of 59.82 with a standard deviation of 12.88. For the Gagne's nine-events of instruction group, the students a mean of 57.96 with a standard deviation of 11.51, Lastly, the lecture method had a mean of 54.30 with a standard deviation of 14.3. The Table also shows that, at posttest, male students taught with Merrill's first principle of instruction groups had a mean score of 61.33 with a standard deviation of 14.22 and their female counterparts had a mean score of 58.70 with a standard deviation of 11.74. The mean difference between the two sets of scores was 2.63, in favour of their male students. For the Gagne's

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Vol. 8, Issue.5, Sep-Oct 2025, p no. 138-156

nine-events of instruction group, the male students had a mean score of 59.78 with a standard deviation of 14.99 and a mean of 59.92 with a standard deviation of8.87 for the female students. The mean difference between the two sets of scores is 0.14, in favour of the females. Lastly, in the lecture method group the male students, had a mean score of 58.03 with a standard deviation of 16.75 and a mean score of 52.04with a standard deviation of 12.23for their female counterparts. The mean difference between the two sets of scores was 5.99, in favour of their male counterparts. These difference shows that there is an interaction effect. To determine if the interaction effect is significant, ANCOVA statistics was used to test H_{013}, and the result is shown in Table 9.

Hypothesis Three: There is no significant effect of interaction between sex and Method on mathematics student's achievement?

To test this hypothesis ANCOVA statistics was used to compare the data collected and the result is shown in Table 9

Table 9: ANCOVA Statistics comparing the interaction effects between methods and sex on mathematics student's achievement

Source	Type 111 Sum of Square	df	Mean Square	F	Sig
Corrected Model	7528.630	6	1254.772	8.466	0.000
Intercept	48961.697	1	48961.697	330.363	0.000
Pre-test	4859.166	1	4859.166	32.787	0.000
Group	1633.252	2	816.626	5.510	0.004
Sex	978.180	1	978.180	6.600	0.011
Group*Sex	212.248	2	106.124	0.716	0.489
Error	46092.049	311	148.206		
Total	1116424.000	318			
Corrected Total	53620.679	317			

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Table 9 shows that the interaction effect between sex and method is not significant at post-test since the calculated significant value of 0.489 obtained is greater than 0.05 alpha level, therefore $H0_{14}$ which states that there is no significant interaction effect between method and sex on mathematics students achievement is not rejected.

DISCUSSION

The first finding of the study showed a significant difference in the mean achievement test scores of Mathematics students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture Method. This means that there are variations in the mean achievement scores. The Merrill's first principles, Gagne's nine-event Instructional Models promotes active participation through hands on and minds on activities at various degrees while the Lecture method promotes more of minds on activities. These activities enabled the students' experience the concepts taught in such a way that they gained knowledge at different rates. This significant difference found may be due to the differences in the abilities of the three methods. The direction of the significant difference as shown using post hoc analysis is between Merrill's first principle of instruction (P= 0.001) and Lecture method and also between Gagne's nine-event of instructional model and lecture method (P= 0.012). This finding agrees with that of Salehi and Ghanbari (2019) who found significant difference in achievement of students taught with Merrill's first principles, Gagne's nine-event Instructional Models and Lecture method

The second finding of the study showed no significant difference in the mean achievement test scores of male and female Mathematics Students taught with Merrill's first principles of instruction, Gagne's nine-event Instructional Models and lecture method. This showed no similarity outcome in the achievement test scores. This may be due to the fact that students irrespective of their sex are made to participate equally during class activities. This act would have given them the opportunity to benefit at equal levels from the class activities hence the non-significant difference found in their post-test scores. This finding agrees with that of Odo, Agwagah, Ugwuanyi, Onesimus, Shiaki, Nwoye, Eucharia, Emejı, Anulika, Okeke, Osakwe, Okeke and Ugwuany, (2021) who found no significant difference in the mean achievement scores of male and female students taught Number and Numeration after being exposed to Merrill's first principles of instruction.

The third finding of the study showed that there is no significant interaction effect between methods and sex on mathematics students achievement. This means that the student's achievement scores was not influenced by sex when the methods were used. This is in agreement with that of Agboro-Eravwoke (2022) and Ajaja (2013) who found no significant interaction effects of methods and sex on achievement.

CONCLUSION

Based on the findings of the study, the following conclusions were drawn.

- Merrill's first principles of instruction and Gagne's nine-event Instructional Models are suitable strategies for teaching mathematics in schools when compared with lecture method. This is based on the fact that these strategies will make mathematics teachers adequately plan, prepare and present lessons that will guarantee learning by students because of the activity involved.
- Merrill's first principles of instruction , Gagne's nine-event Instructional Models and Lecture method are not sex biased.

RECOMMENDATIONS

Since one of the findings has shown that Merrill's first principles of instruction and Gagne's nine-events of instruction model is found to increase student's achievement scores, it is recommended that teachers and students should be properly trained to acquire the skills on usage of Merrill's first principles of instruction and Gagne's nine-events of instruction model and be encouraged to apply them when teaching and learning mathematics.

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