Effects of Gagne's Nine Events of Instruction on Biology Students Academic Performance in Tarauni, Kano State

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Abstract

The study examined the effects of Gagne's nine events of instruction on Biology students' academic performance in Tarauni, Kano State. The study adopted quasi-experimental control group design employing the use of pretest and posttest. The population consists of 2493 senior secondary students in Tarauni, Kano State. A sample of 200 students was randomly selected from four schools out of 21 schools that formed the population. The instrument Genetic Concept Performance Test (GCPT) was validated by experts in the field of test and measurement. The test retest reliability coefficient of the instrument was 0.85. The subjects in the experimental group were taught using Gagne's nine events of instruction, while the subjects in the control group were taught using Lecture Method. Research questions were analyzed descriptively while null hypotheses were tested using t-test. The major finding of the results showed that there was a significant difference between the performance mean scores of students taught genetics concept using Gagne's nine events of instructional strategy and those taught using lecture method in favor of experimental group. There was no significant difference between the mean performance scores of male and female students taught genetics concept using Gagne's nine events of instructional strategy. Based on the findings, it was recommended that the use of Gagne's nine events of instructional strategy should be emphasized in secondary schools across the state.

Keyword: Gagne's Nine Events of Instruction, Biology, Genetic concepts, Academic Performance

Introduction

The role of any instructional strategy is to accomplish the stated objective by employing a structured approach that aligns with the intended learning outcomes. This is essential because a well-designed strategy enhances engagement, promotes understanding, and supports the effective transfer of knowledge or skills to learners. The problem of science teachers' inability to use appropriate pedagogy in achieving learning objectives can lead to poor academic performance. This is because pedagogy plays a crucial role in shaping how students engage with and comprehend the material. Ineffective teaching methods may hinder students' understanding, negatively impacting their academic achievements and overall learning experience.

Biology is usually regarded as the most simple to understand among all the science subjects and thus it is the one that usually attract the highest enrolment. Biology according to Umar (2011) is a natural science subject that deals with the living world, how the world is structured, how it functions, how it develops and how living things come into existence, how they react with one another and with their environment. Similarly, Neteiyin (2012) and Abubakar (2012) have observed that Biology, as a discipline, has contributed tremendously to financial, physical and aesthetic benefits of humanity and to nation building.

The objectives of teaching Biology as a science subject is based on practical and experiment as contained in the National Policy on Education (FRN, 2013) also included among others are to equip learners with meaningful and relevant knowledge of Biology, adequate laboratory, instructional material and field skills. It is expected that, through utilization of Biology laboratory equipment and other instructional materials that the biology students' academic performance could be and the above objectives and goals can be achieved.

Academic performance represents the outcome that indicates the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in schools. In teaching and learning situations, academic performance is synonymous with academic achievement. They could be seen as the outcome of students' effort in examinations. Singh (2013) posited that academic performance is used to measure student's success in educational institutions or how well students meet standard set out by examining bodies or the institution. Okoye, (2018) contended that a student's academic performance is dependent on several factors such as, learning environment, instructional methods and teaching strategy, teachers' attitude and enthusiasm, as well as students' attitude and background. When suitable teaching method is employed during instructional delivery particularly subsumption could improve performance.

Poor performance in Biology among Nigerian secondary school students has been the major concern of parents, teachers and the public. This is why Rabiu, Toriman and Gasim, (2014) says that for decades, individual and other professional bodies such as Science Teachers Association of Nigeria (STAN) have worked tirelessly to deal decisively with students' poor academic performance in science by developing/innovative teaching strategies that would improve learning of science. Scholars such as Aderogba, (2012); Rilwani, Akahomen, and Gbakeji, (2014) have identified several factors influencing students' academic performance in Biology as a course of study including class size, laboratories, instructional strategies, textbooks, guidance and counseling services, academic and professional qualification of teachers, teachers' attributes, students' attributes, peer groups, parental and home background, and school environment among others. Atadoga and Lakpini (2013) have found that the persistent low academic performance in science education were attributed to teachers' instructional strategies such as lecture method in which the learner remained passive while the teacher is always active. They emphasized that lecture method does not promote meaningful learning of science because differences in students' ability are not considered and it cannot satisfy the individual learning mode. Rahamneh, (2017) opined that medium of instruction in teaching biology at post primary/higher education institutions is another factor contributing to poor academic performance in sciences. Thus, instructional strategies use by teachers in the teaching and learning process such as Gagne's nine events of instructional strategy may have a significant influence on learners' academic performance. As such, for learning to take place the necessary condition for learning must be employed such as nine events of instruction proposed by Gagne.

Gagne (1974) defined nine events of instruction as an instructional design that aims to help, develop and deliver a class lesson. These instructional events according to Gagne, (1977) should satisfy or provide the necessary conditions for learning and serve as the basis for designing instruction and selecting appropriate media. The nine events of instruction according to Moallem (2001) are: 1) gaining attention, 2) informing the learner of the objective, 3) stimulating recall of prior knowledge, 4) presenting the stimulus, 5) providing learning guidance, 6) eliciting the performance, 7) providing feedback about performance correctness, 8) assessing performance, and 9) enhancing retention and transfer. By the end of this overall process, Khadjooi, Rostami and Ishaq (2011) claimed that students would be able to draw upon what they had learned in a way that

would permit them to apply their knowledge to new situations. Gagne, Briggs, and Wager, (1992) suggested that the instructors keep in mind that the exact form of these events is not something that can be specified in general for all lessons, but rather must be decided for each learning objective and the events of instruction must be deliberately arranged by the instructors to support learning processes. White (2014) reviewed a number of studies that attempted to validate nine events of instruction developed according to Gagne's principles. He found that these events of instruction have a significant relationship with learners' performance and retention. Adetula (2011) and Oyoleye (2012) noted that students taught using Gagne's nine events of instruction tend to record significantly high academic achievement when compared with those that do not used these events of instruction. In the same vain Driscoll, (2013) reported that Gagne's nine events of instruction has helped in improving academic achievement of senior secondary school chemistry students, as well as their anxiety level. Therefore, this study investigated the effect of Gagne's nine events of instructional strategy on biology students' academic performance in genetics concepts.

Gagne's events of instruction 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 (Gagne, et al 2005; Reiser & Dempsey, 2007; Ahmed, 2011;Tuckman and Monetti 2011; Hanson and Asante, 2014). Accordingly, these events can be used to guide the instructional efforts through a pre-ordained set of steps that meet learning initiatives. The exact incarnation of these events is not something that can be specified in general for all lessons, but rather must be determined for each learning objective. The events of instruction must be deliberately arranged by the teacher to support learning processes. Gagné, et, al (2005) believed that certain mental conditions, or stages, were associated with the learning process which involved a series of "events" that began with drawing students' attention to the subject being taught. From that point, the instructor used a series of steps related to the development of learning expectations, the introduction of stimuli (new information), and the recall of related ideas to move concepts from the student's short to long-term memory. As a result of this belief, he argued that this nine-part approach allowed students to apply their knowledge beyond the confines of in-class activities and to a variety of situations they might encounter. Adetula (2011) and Oyoleye (2012) noted that students taught using Gagne's nine events of instruction tend to record significantly high academic achievement when compared with those taught using lecture method.

Gagne, et al, (2005) say that in order for effective learning to take place, students must give up actively attending to other stimuli, shifting their priorities so that other stimuli are screened out. Some basic ways of commanding attention of the learners include the use of novelty as is often done with animation, a demonstration or some unexpected events. Slavin (2009) suggests that additional ways to gain students attention in class include usage of cues that indicate "this is important" by raising or lowering voice to signal that critical information is about to be imparted, application of gestures, repetition and body position, introducing lesson with demonstration in order to engage students' curiosity and informing the learners that what follows is important.

Gagne et al (2005) has it that "presenting students with learning objectives communicates an expectation of the knowledge and/or skills they are expected to perform." It also argued that "students cannot tell when they have accomplished a learning task and experience the satisfaction of that accomplishment unless they know what final performance is expected of them". The senses of the learners must be activated for effective learning to take place (Slavin, 2009). It is "an activity or information that presents the content of what has to be learned" (Reiser et al. 2007). In an attempt to present the stimulus, "the teacher must determine what new stimulus information is required by an objective and how to present that new stimulus information so that students can perceive and retain it (Tuckman & Monetti, 2011). Tuckman and Monetti have it that "to properly combine old and new information and to make it possible for the result to be entered into long-term memory, students must be given help or guidance." They also advise that teachers must plan the technique they will use to guide the learners in a given task and how they will present these techniques. "The essence of learning guidance is to provide support for learners in making connection between what they know and what is being learned"

Eliciting performance has to do with opportunity to practice or otherwise perform what has been learned (Reiser et al, 2007). People learn to do well what they practice (Kauchak & Eggen, 2008). This suggests that students need to demonstrate to themselves and to their teachers that the new learning has occurred. The teacher therefore, needs to elicit the learners to practice what has been taught in class in order to increase permanence in learning. According to Kauchak and Eggen (2008) feedback means information about existing understanding that we use to enhance future understanding. He also postulates that feedback that follows performance closely in time affects behaviour far more than delayed feedbacks. This suggests that teachers need to give immediate feedback on what students have performed.

Assessment is an opportunity to demonstrate what has been learned (Reiser et al, 2007). According to Hammill (2009) assessment is the act of acquiring and analyzing information about students for some stated purposes, usually for diagnosis of specific problems and for planning instructional programs.

Purposes for assessing students include screening students to find those who need special assistance, to diagnose their problems, to identify their instructional needs, to document their progress in special programs and to provide information for use in research projects.

According to Khadjooi, Rostami, and Ishaq (2011) once learners are reasonably sure that the new capabilities are reliably stored, they can increase the likelihood that they will be retained what have been learned over a long time period by providing practice and spaced reviews. They added that the repetition of learned concepts is an effective mean of enhancing retention, although often disliked by students. Additionally, transfer of knowledge and skills to new problems and situations is a goal of most instruction, but classroom time constraint makes it more difficult to achieve. Additionally, transfer of knowledge and skills to new problems and situations is a goal of most instruction, but classroom time constraint makes it more difficult to achieve. Enhancing retention of learned concept according to Leow, Theng and Neo (2017) the learners should practice the procedure on a dummy a few times. More frequent practice broken by rest periods is more effective retention of learned concept.

With regard to genetic concepts, Albaladejo and Lucas, (2012) shown that students do not fully understand chromosomes, genes, or alleles. Slack and Stewart, (2014) opined that many biology students cannot adequately interpret some concepts such as homozygous or heterozygous. Kindfield, (2016) says that many biology students have alternative views of some processes such as mitosis and meiosis and also they do not understand the meanings of probability in relation to genotype and phenotype frequencies in offspring. Therefore, this investigated the effect of Gagne's nine events of instruction on Biology students' performance in genetic concept.

Purpose of the Study

The objective of this work is to determine the:

i. effect of Gagne's nine events of instruction on biology students' academic performance in genetic concepts.
ii. influence of gender on biology students' performance when taught genetic concepts using Gagne's nine events of instruction.

Research objectives

i. What is the difference between the mean performance scores of students taught genetic concepts using Gagne's nine events of instruction and those taught using lecture method?

ii. What is the influence of gender on biology students' performance when taught genetic concepts using Gagne's nine events of instruction?

Research Hypotheses

The following null hypotheses were tested at $P \leq 0.05$ level of significance

H_{O1}: There is no significant difference between the performance mean scores of students taught genetic concepts using Gagne's nine events of instruction and those taught using lecture method.

H_{O2}: There is no significant difference between the performance mean scores of male and female students taught genetic concept using Gagne's nine events of instruction.

Methodology

In this study, a quasi-experimental-control group design, involving pretest and posttest as suggested by Kerlinger (1973) was used. The study involved two groups of control and experimental consisting of both male and female students. A pretest was administered to the two groups, before the treatment to determine their ability level. The experimental group was taught Genetics Concept using Ausubel's Subsumption Instructional Strategy, while the control was taught, the same concept using lecture method. At the end of the treatment period, a posttest was administered to both groups of students in order to determine the effectiveness of the treatment using GCPT. The treatment was carried out over a period of six weeks. The population of the study consisted of all public Senior Secondary (SSII) Biology Students in Tarauni, Kano State. The size of the population is Two thousand Four hundred and Ninety-three students (2,493) in which One Thousand Two-hundred (1,200) were males and One Thousand Two-hundred and Ninety-three (1,293) were female students. Simple random sampling, involving 'balloting method' was used to select four schools out of the twenty-one (21) in the population. This was done by written the name of all the schools that make up the population on a piece of paper and a child was asked to pick four (4) papers randomly. Four schools selected were assigned into control and experimental groups respectively. From the four (4) schools, one intact class of SSII was selected using balloting method of simple random sampling because they were found to be equivalent. This gave a total number of four (4) intact classes for the study, which were randomly assigned into control and experiment groups. Thus, the total sample for the study stood at 200. Of this number, males are 100 and the females are 100. The instrument used for the study was Genetics Concept Performance Test (GCPT). GCPT was adapted from past questions papers of WAEC and NECO and Biology textbooks, which consisted of thirty-five (35) items with multiple choice of letters A-D. GCPT was used for pretest and posttest in order to measure the level of performance among SSII Biology students.

The instrument Genetic Concept Performance Test (GCPT) was validated by experts in the field of test and measurement. The essence of validity certifies if questions were considered to be testing what they are meant to test. The test retest reliability of the instrument was 0.85 which was calculated using Pearson Product Moment Correlation Coefficient (PPMCC)

For effective data collection, the four groups (i.e. two experimental and two control groups) were taught separately for the period of six weeks. Genetic Concept Performance Test (GCPT) was administered to both groups at the beginning which serve as a pretest. The essence of pretest is to ensure that the selected schools were not significantly different in terms of abilities before actual treatment. The selected sampled schools were taught genetic concept for the period of six weeks. The posttest was administered to the four groups in order to determine the effect of the treatment. After two week, Mean and standard deviation were used to answer the research questions. The null hypotheses were analyzed and tested at $p \leq 0.05$ level of significance.

Results

Research Question One: What is the difference between the performance mean score of students taught genetic concepts Gagne's nine events of instruction and those taught using Lecture Method?

Table 1 Descriptive Statistics on difference between the performance mean scores of experimental and control group

Variables	Groups	N	Mean	Std. Dev	Std. Err	M D
Academic performance	Exp.	100	29.49	5.265	.526	16.77
	Control	100	12.72	3.452	.345	

Table 1 showed that difference existed between the mean scores of students taught genetics concept using Gagne's nine events of instruction and those taught using the lecture method. The computed performance mean scores for the experimental and control groups are 29.49 and 12.72 respectively, and their mean difference was 16.71. This implies that students in the experimental group had higher mean scores compared to those in the control group.

Research Question Two: What is the difference between the performance mean scores of the male and female students taught genetics concept using Gagne's nine events of instruction?

Table 2 Descriptive statistics results of the difference in performance mean scores of male and female students in the experimental group

Variables	Groups	N	Mean	Std. Dev.	Std. Err	M D
	Male	50	29.64	5.49	.776	
Academic performance						0.3
	Female	50	29.34	5.08	.718	

Table 2 showed that the mean performance scores of male students in the experimental group is 29.64 and standard deviation of 5.49 is higher than the mean performance scores of their female counterparts with the mean score of 29.34 and standard deviation of 5.08. The mean difference is 0.3 implying that the male students had slightly higher mean scores because they performed better.

Hypothesis One: There is no significant difference between the performance mean scores of students taught genetics concept using Gagne's nine events of instruction and those taught using the Lecture method.

Table 3 Independent t-test statistics on difference between performance mean scores of Experimental and control group

Variables	Groups	N	Mean	Std. Dev.	Std.Err	M D	df	t-cal	P
	Exp.	100	29.49	5.27	.526				
Academic performance						16.77	198	26.63	0.00
	Control	100	12.72	3.45	345				

Calculated p < 0.05 computed t > 1.96 at df 198

Table 3 showed that significant differences existed between the performance mean scores of students taught genetics concept using Gagne's nine events of instruction and those taught using the Lecture method. Reasons being that the calculated p level of 0.00 is lower than the 0.05 alpha level of significance and the computed t value of 26.63 is higher than the 1.96 t-critical values at df = 198. Their computed performance mean scores are 29.49 and 12.72 of students taught genetics concept using Gagne's nine events of instruction and those taught using the lecture method in favour of the experimental groups. Therefore, the null hypothesis one rejected.

Hypothesis Two: There is no significant difference between the posttest mean performance scores of male and female students taught genetics concept using Gagne's nine events of instruction.

Table 4 t-test Comparison of the posttest mean performance scores of male and female students in the experimental group

Variable	Groups	N	Mean	Std. Dev,	Std. Err	M D	df	t	p
	Male	50	29.64	5.49	.776				
Performance						0.3	98	0.284	0.77
	Female	50	29.34	5.08	.718				

*Not significant at P≥ 0.05

Table 1.4 showed that there was no significant differences in the posttest performance mean scores between male and female students taught genetics concept using Gagne's nine events of instruction in the experimental group. Reasons being that the calculated p level of 0.77 is greater than the 0.05 alpha level of significance and the computed t value of 0.284 is lower than the 1.96 t-critical value at df 98. Their computed performance mean are 29.64 and 29.34 by male and female Students taught genetics concept using Gagne's nine events of instruction respectively. The mean difference is 0.3 in favour of the males, although this difference was not significant. Therefore, null hypothesis two is retained.

Discussion of findings

The result of this study showed that significant differences existed between mean performance scores of students taught genetics concept using Gagne's nine events of instruction and those taught using the Lecture method. The finding of this study is in agreement with the finding of Sabiru (2013) who revealed that students taught using Gagne's nine event of instruction recorded high academic achievement than those taught using to lecture method. In the same vein, White (2014) reviewed a number of studies that attempted to validate nine events of instruction developed according to Gagne's principles. He found that these events of instruction have a significant relationship with learners' academic performance. The finding of this study is in contrast with of Driscoll, (2013) who reported that Gagne's nine events of instruction do not have significant impact in improving academic achievement of senior secondary school chemistry students. In the same vein, the finding of this study is in contrast with that of Prima and Sinnadurai (2016) who investigated the relationship between Gagne's nine event of instruction and academic performance among engineering students using quasi experiment. Their finding showed that there was no significant correlation of Gagne's nine event of instruction and low academic performance among engineering students.

It was also showed that there was no significant differences in the posttest performance mean scores between male and female students taught genetics concept using Gagne's nine events of instruction in the experimental group. This finding is in agreement with the finding of Nadeem, Ali, Maqbool and Zaidi (2012) who studied the impact of Gagne's nine events of instruction on the Academic performance of Students at University level in Bahawalpur, Pakistan. The in depth investigation of the findings obtained through the analyzed data reveals that Gagne's nine events of instruction had its impact on academic performance of male and female students. Muhammad (2014) found that female subjects were significantly better than their male counterparts. In contrast Muhammad, Syed and Khalid (2015) found significant difference between male and female students on academic performance scores, which indicate that female students have high scores on academic performance as compared to male students.

Conclusion

It has been concluded that Gagne's nine events of instruction can improve students' academic performance when taught genetics concept. This is evident in the finding of hypothesis one that students taught genetics concepts in the experimental group has significantly higher academic performance mean scores than their counterparts taught same concept using the Lecture Method. Also, Gagne's nine events of instruction can improve academic performance of both male and female students in the experimental groups if properly implemented. This is apparent in the finding of hypothesis two that both male and female students in the experimental group taught genetics concepts using the Gagne's nine events of instruction has significantly higher academic performance mean scores with a slight differences. This infers that Gagne's nine events of instruction is gender friendly.

Recommendations

1. The use of Gagne's nine events of instruction should be emphasized and rigorously implemented in secondary schools across the state because students taught using this instruction strategy exhibited remarkable academic performance when compared with their counterparts taught same concept using the lecture method
2. Curriculum planners should examine the effectiveness of Gagne's nine events of instruction and consider their suitability for teaching science concepts since it has the potential of bringing about meaningful learning and improving students' academic performance of both male and female students, thus, it is gender friendly.

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