GALLERY WALKS AND MIND MAPPING STRATEGIES AS DETERMINANTS OF STUDENTS' LEARNING OUTCOMES IN GENETIC CONCEPTS IN BIOLOGY IN KWARA STATE, NIGERIA

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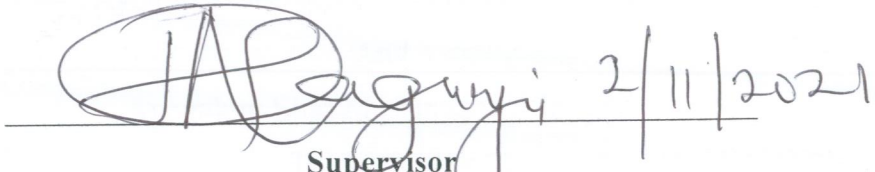
CERTIFICATION

I testify that this research work was carried out by Gabriel Segun ADEWUMI, with Matric. No. 167277, under my supervision in the Department of Science and Technology Education, Faculty of Education, University of Ibadan, Ibadan, Nigeria.



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DEDICATION

This research work is dedicated

To the Maker of my life

ALMIGHTY GOD

To my wife

Rachel Temitope Adewumi

To my boys

Ayomide Hephzibah Oluwatunmise Adewumi,

Ayodeji Wisdom Erioluwa Adewumi,

Ayomiposi Jedidah Oluwaferanmi Adewumi

And

Ayomikun Elias Morianugba Adewumi

To my mother

Grace Abosede Adewumi.

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God bless you.

ABSTRACT

Genetic concepts are topics in secondary school biology devoted to the study and manipulation of heredity and variation in living organisms.However, reports have shown that students' achievement in these concepts is poor in Kwara State.This has been attributed to the use of teacher-centred methods ofinstruction. Previous studies concentrated largely on teacher and students-related socio-psychological factors with little consideration for student-centred learning strategies. This study, therefore, was carried out to determine the effects of Gallery Walks Strategy (GWS) and Mind Mapping Strategy (MMS) on students' learning outcomes (attitude, achievement and process skills) in genetic concepts in biology in Kwara State, Nigeria. The moderating effects of mental ability and learning styleswere also examined.

Vygotsky Social Development and Piaget's Development theories provided the framework. The pretest-posttest control group quasi-experimental design with a 3x3x3 factorial matrix was adopted. Three Local Government Areas (LGAs) were randomly selected fromKwara State.Three public Senior Secondary Schools were randomly selected from each LGA, while an intact class of Senior School II learners was selected from each school. The participants in the schools were randomly assigned to GWS (109), MMS (121) and control (135) groups. The instruments used were Genetic Concepts Achievement (r=0.86), Mental ability(r=0.87) tests, Attitude to Biology (α=0.89), Science Process Skills (r=0.83), Students' Learning Styles(r=0.81) scales and instructional guides.The treatment lasted eight weeks. Data were analysed using descriptive statistics, Analysis of covariance and Bonferroni post-hoc test at 0.05 level of significance.

The participants' age was 17.15±2.35 years, 51.7% had moderate mental ability and 43.6% had visual learning style. The treatment had a significant main effect on student achievement ($F_{(2,361)}$=17.62; partial η^2=0.01). The participants in MMS had the highest post-achievement mean score (19.34), followed by GWS (16.52) and control (14.76) groups.The treatment had a significant main effect on students' attitude to biology ($F_{(2,361)}$=10.84; partialη^2 =0.06). The participants in GWS had the highes tpost-attitude mean score (56.68), followed by MMS (55.68) and control (50.38) groups. The treatment had a significant main effect on students' science process skills in biology ($F_{(2,361)}$=30.64, partial η^2=0.16). The participants in GWS had the highest post-science process skills mean score (59.85), followed by MMS (56.78) and control (47.70) groups.There was asignificant interaction effect of treatment and mental ability on students' achievement in biology ($F_{(2,361)}$=3.89; partial η^2=0.05) in favour of high mental ability students in MMS group. The interaction effect of treatment and mental ability on science process skills in biology was significant ($F_{(2,361)}$=3.44;partial η^2=0.04) in favour of high mental ability studentsin GWS groups. The interaction effects of treatment, mental ability and learning style on science process skills in biology was significant ($F_{(2,361)}$=2.40; partial η^2=0.05) in favour of high mental ability auditory learning style students in GWS group.The other two and three-way interaction effects were not significant.

Gallery Walks and Mind Mapping teaching strategies enhanced students' learning outcomes in genetic concepts in biology in Kwara State, Nigeria with emphasis on learning style and mental ability. Therefore, these strategies should be adopted in teaching Biology in secondary schools.

Keywords: **Gallery Walks and Mind Mapping Strategies, Genetic Concepts in Biology, Science Process Skills, Students Performance in Biology**

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Operational Definition of Terms

Achievement in Biology: This refers to students scores in pre-test and post-test derived from Biology achievement Test based on the students' knowledge of genetic concepts in Biology.

Attitude: This refers to students feelings towards biology and is measured by the scores derived from Students Attitude Towards Biology scale (SATBS).

Science Process Skills: This refers to students scores in pre-test and post-test derived from Biology Students Science Process Skills Scale (BSSPSS)

Learning Style: This refers to the students' scores inBiology Student Learning Style Scale (BSLS).

Mental Ability Test: This is students scores derived from Biology Students Mental Ability Test (BSMAT)

Conventional Strategy: This is the teaching strategy used to teach Genetic concepts in Biology in schools selected for the study. It involves the teacher doing most of the activities in the classroom, like demonstrating, performing experiments and talking during the lesson, while the students remain passive, listening to the teacher and sometimes are allowed to take part in the activities

Gallery Walks Strategy: Is a strategy that gets students out of their chairs and actively involves them in synthesizing important concepts, in consensus building, in writing, and involves the teams to rotate around the classroom, composing answers to questions as well as reflecting upon the answers given by other groups. It engage students in active participation and development of critical thinking ability on genetic concepts in Biology.

Learning Outcomes: This refers to cognitive achievement, attitude and Science Process Skills of students in genetic concepts in biology.

Mind Mapping Strategy: is a visual diagram used to record and organize information in a way which the brain finds captivating and easy to process. Thoughts, ideas or facts are laid out around a central theme so that you can clearly 'see' their flow across different levels. It engage students in schematic activities and student construct their own knowledge on genetic concepts in Biology.

List of Acronyms

Gallery Walks Strategy –	GWS
Mind Mapping Strategy –	MMS
Conventional Strategy -	CS
Science Process Skills	SPS
Federal Ministry of Education	FME
Estimated Marginal Mean	EMM
Treatment	Trtmt
Table	Tab.

CHAPTER ONE
INTRODUCTION

1.1 Background to the study

Biology is a unique captivating field of study, and an interesting subject that has been intriguing scientific minds for several centuries. It is so significant in our world; the basis of our origin and existence on earth lies within the depths of the Biological science. It plays a crucial role in every ones lives and touches almost every aspect of our existence; it helps human life in many ways. It helps in expanding creation of food, battling illnesses and helps in securing and preserving our current environment the advances in the field of science especially in biology have brought about high standard of living in the area of food and wellbeing. Crop yield is on the increase due to the fact that there are hybrids both in plant and animals which can resist drought, diseases and infection.Sallau, Abubarkar and Sani (2018) reported that Biology is the science of life.

Chukwuemeka, (2011) stressed the importance of biology that a sound theoretical and practical knowledge of Biology is very necessary for the management of our natural resources, provision of good health facilities for the masses, adequate food supply and favorable life environment. In addition, the contributions of the Biologist are critical and dynamic in industries, technologies, crime detection, controlling of environmental pollution, diseases control, population control, and in factual sciences (Biology, Physics and Chemistry).

The particularaims to be attained by Biology curriculum, as specified in the National Policy on Education NERDC, (2013), include the following: to understand certain key biological concepts essential for positive living in a world of science and technology; to illuminate the problemsof sex, reproduction, growth, pollution, health for the benefit of the society; to develop the ability to apply scientific knowledge to everyday life in the areas of personal and community health , as well as agriculture; to make rooms for technological advancement ;to disperse superstitions beliefs in a technological method and to develop an awareness of the environment.

In spite of the fact that Biology curriculum has a robust and reliable objective for biology as a teaching subject student still find some Biological concepts difficult to understand such as genetics, enzyme and chromosome. Cimer, (2012) reported that genes,chromosomes, Mendelian genetics and hormones are seen asproblematictoipics by Senior Secondary School students. Students may tend to hate such perceived difficult topics in biology; hence there is high tendency for students to avoid answering questions on such concepts during examination. Chief Examiner's Reports WAEC, (2011) stated that students avoid questions on genetics diagram, few candidates that attempted it, got it wrongly. Tamarin, (2007) reported that students' avoid questions on genetics in public examinations. This genetic concepts that students 'are trying to avoid in secondary school has numerous advantages that will be useful for them in future.

Genetics is the study of genes, genetic variation and heredity in organism. It focuses on establishing the scientific basis for understanding of how characteristics or traits are transferred from parents to their offspring from one generation to another. The scientific understanding of genetics principles had also lead to the application of genetics in industry. For instance, in modern times genetic engineering is used to improve the quality of crops and domestic animals Tamarin, (2007). Another interesting area of genetics is application of genetics to solve society problems using deoxyribonucleic acid (DNA) test in crime detection and establishing of paternity where there is dispute. In genetics, students learn certain aspects of gene and their mode of transmission from generation to generation (heredity). Such knowledge should help students to understand problems of genetic nature rather than relying on superstition and other mystical explanations.

Students also learn accurate scientific ways of explaining the genetic defects that may be found in their families and communities. Despite, the advantages that students stand to derive from knowledge of genetics, majority of them are finding the concept difficult to understand. The reason may be facts, that genetics is one of the abstract concepts in Biology and it requires high cognitive mental ability level to understand such concepts. Another reason may be as a result of inappropriate teaching strategies that teachers employed. In addition, there are many terms in genetics that look-alike and sound alike; this may lead to confusing these terms and having difficulties in understanding the genetics concepts. The observed poor performance of students in SSCE Biology may not be unrelated to their perception of

difficulties in understanding certain areas of biology which are regarded as complex concepts which is abstractic in nature such as concept genetics.

Available statistics from West Africa Examination Council (WAEC) and Chief Examiners Reports on senior secondary school student's performance in biology revealed a very poor performance at Senior Certificates Examinations. Also, table 1.1 showed the Percentage Distribution of Students' Performance in May/June Senior Secondary Certificate (SSCE) in Biology in Nigeria from 2008-2019. According to Ogundiwin, (2013) and Awolere, (2015) the achievements of students in Biology remain low in Nigeria especially in public examinations such as NECO and WASSCE. The analysis of (SSCE) Result in Table 1.1 made available from the (WAEC) Statistics Unit on total number of students who sat for Biology Examination with their performance exposed the degree of this problem.

Table 1.1: Percentage Distribution of Students' Performance in May/June Senior Secondary Certificate (SSCE) in Biology in Nigeria: 2008-2019

Year	Total no of students that sat for the examinations	Total no of credit passes	% Credit A1-C6	% Failure
2008	1,259,964	427,644	33.94	66.06
2009	1,903,552	644,733	33.87	66.13
2010	1,300,418	427,644	33.90	66.06
2011	1,505,199	579,432	38.50	61.50
2012	1,672,224	649,156	38.81	61.20
2013	1,646,741	850,772	51.66	48.34
2014	1,356,243	511,956	29.34	70.66
2015	1,145,228	371,628	24.39	75.61
20-16	1,200,367	740,345	61.68	36.32
2017	580,449	394,299	68.03	30.92
2018	1,087,063	678,299	62.48	35.52
2019	1,033,304	775,103	75.01	23.93

Sources: Statistics Section, WAEC National Head Office, Yaba Lagos Nigeria;

Table 1.2: The analysis of Senior Secondary Certificate Examination (SSCE) Genetics related past questions from 2006-2018.

Percentage statistic data on Genetics concept related WAEC Questions from 2006-2018.

YEARS	OBJECTIVES QUESTIONS			ESSAY/ THEORY QUESTIONS		
	TOTAL NO OF QUESTIONS	AVAILABLE QUESTIONS ON GENETICS	% OF QUESTIONS AVAILABLE ON GENETICS	TOTAL NO OF QUESTIONS	AVAILABLE QUESTIONS ON GENETICS	% OF QUESTIONS AVAILABLE ON GENETICS
2006	60	6	10.00	6	0	0.00
2007	60	7	11.66	6	1	16.70
2008	60	7	11.66	6	0	0.00
2009	60	6	10.00	6	0	0.00
2010	60	7	11.66	6	1	16.70
2011	60	6	10.00	6	1	16.70
2012	60	9	15.00	6	1	16.7
2013	60	8	13.33	6	0	16.7
2014	50	7	14.00	5	1	20.00
2015	50	7	14.00	5	1	20.00
2016	50	8	16.00	5	1	20.00
2017	50	5	10.00	5	1	20.00
2018	50	7	14.00	5	1	20.00

Source: Past Questions and Answers for WASSCE (1988-2018) edition

The table 1.1 showed the percentage of credit passes and failure from year 2008 to 2019. Based on the result provided by West Africa Examination Council, it was deduced that D7 and E8 has been regarded as failure since it is expected that a candidate should pass at least a credit level in any of the subject registered and written (WAEC, 2019). In year 2008 to 2012 the percentage of credit passes was poor and it was glaring that the percentage of credit pass did not above38.81% for the period of five years. In year 2013 and 2016 to 2019, good academic achievement was recorded in Biology in which the percentage credit passes jumped from 51.66% to 75.01% and the percentage failure dropped from 48.34% to 23.93%. From 2013 to 2015 the percentage credit passes reduced from 51.66% to 24.39%, while the percentage of failure during the same period increased from 48.34% in 2013 to 75.61% in 2015.

The students' performances were inconsistent in the years under consideration. It is glaring that the percentage numbers of students that do pass Biology at the Credit level fluctuates over the examined years (2008 – 2019). For example in Year 2016, 61.68% of students passed at credit level. In Year 2017, it increased to 68.03% but dropped to 62.48% in Year 2018. Year 2019 student made high improvement with 75.01% passing at credit level. The fluctuation shown in table 1.1 could be as a result of various conclusions drawed by different scholars on the reasons why students failed Biology in Secondary Schools, lack of good teaching good strategies (Olagunju and Babayemi, 2014), outdated teaching practices (Olagunju, 2006), shortage of qualified teachers (Ajayi, 2005), using teachers centered instructional strategy which have no bearing on the learners' practical life (Adodo and Gbore, 2012), Inadequate materials in for teaching science in schools (Olagunju, 2006) and teachers' inability to satisfy the learners' aspirations or aims (Fasasi, 2014).

Table 1.2 showed Percentage of Genetic Concepts related WAEC Questions from 2006-2018. It also shows the total number of Objective Questions from 2006 to 2013 is 60. The number and percentage of genetic concepts related objective questions set by WAEC during this period fluctuates but tends to be on the increase in percentage from 10% in 2006 to 13% in 2013.Also, in 2014 to 2018 the total number of Genetic Concepts related objectives questions dropped to 50% . During this period the percentage of Genetic Concepts related objectives questions set by WAEC is seen to be fluctuating with 14% in 2014, 2015 and 2018 respectively. However, it is seen that in 2016 the percentage rose to 16% and dropped to 10% in 2017. In addition, the total number of Genetics related essay questions set by WAEC from 2006 to 2013 was 6.

The percentage of Genetic Concepts related essay questions during this period is shown to fluctuate between zero and one with 0% and 16.70% respectively. Also, in 2014 to 2018 the total number of essay questions dropped to 5. During this period WAEC has steadily been awarding one question to Genetics which shows 20% of the total number of Genetic Concepts related essay questions set during this period.

The percentage credit passes for the year 2008 to 2012 and 2014 to 2015 were not good enough most especially for students whose course of study require a credit pass in Biology in order for them to gain admission into higher institution. This was in line with the submission of (Ogundiwin, 2013). Awolere, (2015) reported that the performance of Biology students' has regularly been poor in spite of the effort made by the government and researchers to correct and improve it over the years. Ogundiwin, Asaju, Adegoke and Ojo, (2015), at the time of citing from WAEC and NECO Chief Examiner's Reports stated that students learning outcomes in Biology is a bit higher than other science subject when compared with them and it resulted to situation whereby the academic aspiration of the students were affected. This was supported by Chief Examiner's Reports.

The West Africa Examinations Council's, Chief Examiner's report May/June (2006) stated that candidate performance was poor. Executive summary of Chief Examiner's Reports of WAEC in Nigeria Nov/Dec, (2006) stated that candidates'performance was reported to be poor in many subjects. In the Chief Examiner's reportsWAEC in Nigeria May/June, (2007) reported that many Candidates could not define gene and gene mutation. In addition, Chief Examiner's reports WAEC in Nigeria Nov/Dec, (2007) stated that candidates could not properly define sex-linked characters, co-dominance and they cannot give appropriate examples; also, most candidates who attempted genetic crossing performed poorly. They could not properly represent the parents as X^h X^H and X^H and Y and the gametes as (X^h) (X^H) and (X^H) (Y). They did not do the crossing well.

They could neither state the phenotypes and genotypes of the F_1 offspring nor the probability of the couple having hemophilic sons. This is supported by Chief Examiner's Reports WAEC in Nigeria Nov/Dec, (2009) andChief Examiner's Reports of WAEC in Nigeria (2010) which revealed that most of the candidates could not list transmittable characteristics. Most candidates who attempted the genetic diagram perform it wrongly.

WAEC Chief Examiner's Report (2010, 2012) stated that candidates failed to differentiate between genotype and phenotype. Chief Examiner's Reports NECO (2012) stated that students were unable to distinguish between normal genetics crossing and sex-linked gene crossing. Large numbers of the candidates that sat for 2012 Biology Examination (WAEC) can not perform genetics crossing. It also, the same with the Chief Examiner's Report's NABTEB (2012) reported that students have limited knowledge of genetics. Chief Examiner's Report's WAEC (2013) reported that candidates were unable to draw genetics crosses properly .They did not do well in genetics diagram. WAEC Chief Examiner's Report (2018) pointed out the following observed weaknesses of students, poor grasp of genetics and not putting 'X' as a sign of genetics crossing.

Consequently, students' poor performance has revealed by chief examiner reports might bebecause students develop negative attitude towards the subject (Biology). Attitude is an emotional state of individual towards an object or situation. Oliver and Simpson (2008) stated that attitude is the extent (degree) at which learners'likes' science. Also, attitude is an inclination to reason, sense, and perform decidedly or contrarily in the direction of objects in our present environment. Attitude can be seen as having three primary parts: psychological, affective and behavioural segments (component).Attitude is the acquirement of definiteframe of mind about something or somebody, either constructive or destructive that impacts his/her choice of action in a consistent way. Ajayi, (2007) stated that student's bad attitudes to biology make them perform poorly in science subjects most especially in biology.

Scott, (2006) also asserted that a student's attitude towards a particular discipline may affect their motivation to excel in that subject.In the view of Akinsola, (2009), attitude is very crucial in the teaching and learningprocess. Hence, teachers play an important role in the formation of their students' attitude. Pavol, Gaye and Julia, (2007) reported that the teacher affects student's attitudes towards biology. Attitude can be positive or negative predisposition towards a particular organization and it also involves behavior. Awolere, (2015), in his research, confirmed that attitude can be modified from bad to good or from good to bad in the course of passing across information to the students this is supported by Akinsola, (2013). Attitudes are attained during learning and can be improved by encouraging the students using varieties of methods. However, attitude changes slowly, individuals continually develop new attitude and adjust old ones when they are open up to new fact and new events. The benefit of

having a positive attitude towards biology cannot be under-estimated as attitude is a propensity of an individual to respond in a certain way to a stimulus (internal or external).

Although, attitude is important in science especially in Biology one cannot rule out the importance of science process skills, for it is a foundation of problems solving in science class (Adegoke, 2015). Science Process Skills (SPS) is a special skill that Biology students need to possess in order to concretize an abstract concept (genetic concepts) in Biology. To buttress these pointsm Mutiu and Temiz, (2013) revealed that science process skillis the reason for logical reasoning and exploration. Science process Skills are the abilities that encourage mastering in actual sciences, guarantee dynamic learners interest, have learners build up the feeling of undertaking obligation in their own learning, increase the perpetual quality of learning, and further rmore have learners gain method of carrying out research and strategies, that, is, they guarantee thinking and acting like a researcher.

They are indivisible practically speaking from the reasonable arrangement that is engaged with learning and applying science.In the study of Awolere, (2015) he reported that students do not possess sufficient science process skills that can aid their problem solving skills. This may have been caused by the instructional strategies used in teaching and learning of Biology, which do not promote the development of science process skills. This therefore suggests that a self-activity based teaching strategy which facilitates student' participation and active involvement in the learning of science would be a viable option for addressing problems associated with students' lack of science process skills in Biology. Moreover, past researches found out that science subject are taught in abstract way without using science process skills. WAEC Chief Examiner's, in Biology has reported that students do have problems in science process skills. They have therefore suggested that because of the poor science process skills demonstrated by the students, there is the need for the Biology teachers to help students develop these science process skills aquisition by teaching them better (Chief examiner's report, 2007). Available statistics from WAEC and Chief Examiners Reports on senior secondary school student's performance in Biology showed a very poor performance at Senior Certificates Examinations especially in the esssay and practical assessment where learners display negative and very poor acquisition of science process skills acquisition. Student's possessing poor acquisition of science process skills in science subjects is not in accordance with the targets of

government that is Nigeria Policy on Education (NPE), Nigeria which laid emphazis on assisting studentsto secure fitting abilities, capacities and skills, both mentally and physicallywhich will enable them to live and add to the advancement of his environment (FME, 2014).

Science process skills (SPS) as explained by Awolere, (2015) they are special skills that learners and teachers use in carrying out mental operation on physical activities in the field of science. Science process skills are known as methodical skills that experiment and investigates science conducts of the mind. It is an effort to createawreness for the student as well as comprehends the techniques scientists used in carrying out their work and the need to be equipped and prepared with likely careers in science and technology that will lead to development of science process skills. Osvardo, (2012) reported that students' required mental ability to compute simple and essential activities in science class. Milan, (2012) supported this in his finding when he reported that a major obstacle to the improvement of science process skills is to focus on teaching science skills in isolation from their real world application.

The American Association for the Advancement of Science (AAAS) identifiedfifteen of these skills (Richard,2013). These skills are:Observation; Measuring;Classification;Experimenting/Manipulating of Apparatus;Communication /Recording; Predicting; Inferring; Counting / Numbering; Using space/time relationship; Questionnaire; Controlling variables; Hypothesizing; Defining operationally; Formulating models; Interpreting data; Labeling. All these skills promote the development of critical thinking skills ability and scientific reasoning of the learners in the science class. Despite, the important of science process skills in acquisition knowledge and skills. Jack, (2013) in his research study discovered that over 68% of students still experience difficulty inacquiring science process skills, that is only 30% of students acquired the requiredscience process skills.

All these dependent variables (achievement, attitude and science process skills) need to be improved upon on the students through teaching using appropriate instructional strategies. Among the strategies that have been previously used are; Experiential Strategy by Awolere, (2015), Critical Exploration Strategy by Oloyede, (2014), Puzzled Based Critical Thinking Motivation Strategies by Ogundiwin, (2013) to mention few.

In spite of all these strategies, students still experienced high rate of poor performance in the senior secondary school certificate examination as seen in Table 1.1. The students poor performance in science process skills acquisition in Biology have been attributed to the inappropriate strategies of teaching mainly employed by most Biology teachers. Researchers have revealed that the teacher-centered strategy normally used by the teachers would not assist the learners to be active recipient of knowledge by which the achievement can be improved (Ogundiwin, 2013; Babayemi, 2014 and Awolere, 2015.) Scholars have therefore suggested the use of active teaching and learning strategies to take care of the deficiencies.

One of the suggested active strategies is Gallery Walks Strategy. Mark, (2006) defined Gallery Walks Strategy as a teaching and learning strategy that allow students' to be actively engaged as they walk throughout the classroom. They work together in small groups of three to six share ideas and respond to meaningful questions, documents, images, problem-solving situations or texts. The scholar attribute the usage of Gallery Walk Strategy to the science subject, Mark, (2006) confirmed it that Gallery Strategy is an exciting strategy that for promote class discussion in the science classroom. John, (2013) revealed that Gallery Walks Strategy enables learners to improve their work through the use of feedback from multiple sources such as peers, teachers and experts. During Gallery Walks according to Mark, (2006) and David, (2015) students' explore multiple texts or images that are placed around the room.

Carolyn, (2012) reported that Gallery Walks is a discussion strategy that engages groups of participants as they examine and respond to a document; often these document (or items) are displayed on a wall and the participants move as a group from one to the next station. The teacher use Gallery Walks Strategy as a way to have students share their works with peers, examine multiple documents or respond to a collection of quotations, This is supported by John, (2013) who confirmed that Gallery Walks is a way of sharing of knowledge by students after they have read something or done research or as a way for students to share research or to generate discussion on a topic or concept. Gallery Walks Strategy introduced students to new materials that will help them to obtain specific information that will allow them to develop

cognitively. According to David, (2015) a traditional Gallery Walks requires teams of students to rotate between stations to answer or build on other teams answers at each station. Once all teams have visited each station oral presentation and discussion by the class follows.The focus of this research study is therefore, to determine the effects of Gallery Walks and Mind Mapping Strategies on students' achievement, attitudes, and science process skills in genetic concepts in Biology.

Mind Mapping is another active strategy. Busan, (2000) defined Mind Mapping Strategy as a teaching strategy which is visual and non-linear representation of ideas and their relationship. He described the strategy as student-centered. Another proponent of Mind Mapping Strategy were Lea, Stephenson and Troy, (2003) they defined Mind Mapping Strategy as the one that allow learners to be active rather than passive listener and emphasized deep learning and understanding. Mind Mapping has been described as one of the teaching strategy that promotes creative thinking, ability and high retention in learners. It is also a powerful tool that can be used by teachers to facilitate learning (Batdi and Yusuf, 2015). It enhances the development of certain skills in learners such as thinking skills, reasoning skills, and] ability to make decision, taking action, information gathering and generating skills.

Mind Mapping use letters, numbers, color and image, which means that they engage the left and the right sides of the brain. The thinking power of learner will increase synergistically when using Mind Mapping. The consequence of the investigation offer research help to the hypothetical statements that Mind Mapping can possibly affect learners learning with regards to Secondary School Science. In the perspective on Brinkmann, (2003), Mind Mapping Strategy improved learners' scholastic accomplishment and supports the understanding of the content. Another name for Mind Mapping is idea mapping which has been characterized as 'visual, non-direct portrayals of thoughts as indicated by Biktimirov and Nilson, (2006). Be that as it may, in Mind Mapping, any thought can be associated with some other. Freestyle, unconstrained reasoning is required while making a Mind Mapping, with the point of finding inventive relationship between thoughts. Along these lines, Mind Mapping is basically affiliation Maps.

Several moderating variables have been detected to have an affect on research work in any field of study irrespective of the strategy or method used. These moderating

variables include mental ability, learning style, gender, socio-economic status of the parents, parental educational background, school type, school location, cognitive style and many more others.

It has been noted that ability of learners to retain quality information received in the class during teaching and learning processes and score high in cognitive activities can be associate with mental ability. Student's mental ability is one of the factors that might affects student's achievement in solving problem in biology class. Olagunju and Chukwuka, (2008) reported that mental ability has been established to impact performance of learners in biology. Inyang and Ekpenyong, (2000) used a standardized mental ability tests as proposed by Australian Council for Educational Research (ACER) to categorise the level of performance of students into two mental ability levels; high and low. Most of the problems encountered in academic setting by the students can be described in terms of their mental ability (either high or low). Akinwumi, (2009) describe mental ability as the level of cognitive achievements demonstrated when pupils are exposed to education processes which make them to progress from a state of ignorance to a level where knowledge and skills are acquired and utilise.

The overall objective regulating the consideration of mental ability is that it has ability to differentiate between the low and the high ability students (Ehikhamenor, 2012). Akinbobola,(2015) reported that students with high ability to cope with academic task and students with low ability could be trained and motivated to improve their ability. Mental ability is the power to learn or retains knowledge.Cohen, (2013) reported that testing of cognitive skills is a degree of mental ability of students. Studies have found that learners with advanced general mental ability obtainadditional academic knowledge and obtain it more rapidly than others. Higher levels of academic knowledge lead to better performance (Ehikhamenor, 2012). Akinbobola, (2015) observed that the the educational system in Nigeria is made up of students with various ability levels. Therefore, any improvement in teaching strategy must reflect the impact of learners' ability level.

Despite the fact that researchers attribute the poor achievement of students in science to teaching strategies and mental ability of the students, other science educators are of the view that learning style is one of the determining factors of poor achievement in science. It has been noted that, Students are not the same especially when we find out the way at which they learn and process information in science

class. Rajshri, (2013) defined learning style as the the capacity of students to see and handle data in learning circumstances. Learning styles are the manners in which that student learn or process information. Everybody has a blend of learning styles. A group may find that they have a common technique for learning, with absolutely less utilization of different styles. There is no correct blend. Nor are your styles fixed. You can make limit in less prevalent styles likewise as additional make styles that you as of now utilize well.The individuals who utilize less preferred learning styles frequently end up in lower classes, with different not-so-free marks and some of the time lower quality instructing. Quite possibly the main employments of learning styles is that it makes it simple for the instructors to join them into their educating.This is to say that, there is disparity in the ways students think, perceive and analyze a stimulus configuration. It is the view of Norasyikin, Miniand Aini, (2015) that learning style helps students to achieve good academic record in science class.

Learning Style has been characterized by different researchers generally as a sign for singular contrasts. These distinctions may show itself in 'ways of life's and surprisingly in character types Zhang and Sternberg, (2005). Learning style has been describle as an individual preferred or habitualways of processing and transforming knowledge.Learners learning styles have been found to have critical impacted on the achievement of the learners in Biology (Okoye, 2014). The majority of the difficulties learners experienced in learning could be portrayed as far as various manners by which learners think, see, measure and dissect an upgrade design. Each individual responds differently when exposed to a stimulus environment.

Many studies had been carried out on similar topic both at the national and international levels, focusing on the use of instructional strategies to improve students' achievement. Works have been carried out on each of the two strategies separately and on different subjects. However, not much has been done using these two strategies together in the area of genetics in Biology. It is this gap that this research work stands to fill. This research work determined the impact that Gallery Walks and Mind Mapping Strategies have on learners Achievement, Attitudes and Science Process Skills Acquisition in genetic concepts in Biology. It also examined whether learning style of the students and their mental ability have any effects/influence on the students learning outcomes in genetics concepts in Biology.

1.2 Statement of the Problem

As important as Biology is to career pursuant in science courses; However, past Chief Examiners' Reports on public examination West Africa Examination Council (WAEC) revealed students' inability to define genetics terminologies and interpret the questions on genetics, and inability of candidates to differentiate between genotype and phenotypes and most of the candidates were unable to perform genetic crossing properly. The report further revealed failure of candidates to list transmittable characteristics. Most candidates have poor knowledge of the application of genetics in marriage counselling. Poor grasping of genetics and not putting "X" as a sign of genetics crossing. Students avoid questions on genetics diagram; few candidates that attempted it got it wrongly.

The poor handling of the genetic concepts by instructors who adopt the teacher-centered teaching strategies worsen the problem. Some candidates' weaknesses also include inability to distinguish between normal genetics crossing and sex-linked characters crossing. They could neither state the phenotypes and genotypes of the first filia generation (Fi) offspring nor the probability of the couple having haemopholic sons: inability to define gene and gene mutation. Attempts to confront these problems have led scholars and researchers to embark on intervention programme on teaching and learning science such as building teacher-student relationships, adapting the environment; managing sensory stimulation, changing communication strategy, intervention role play among others. Despite this interventions, the performance of students in genetic concepts in Biology has not satisfactorily upgrade, thereby, supporting doubt that other factors could be responsible such as home factors, students factors, school factors, gender emotional intelligence and psycho-social factors, students' mental ability and learning styles which this research study investigated.

Relevant studies have revealed the connections between these variables and students performance in Basic Science, Social Studies, Mathematics, Yoruba Language, Geography, Economics to mention a few, but relatively none in genetic concepts in Biology. Thus, there is need for further studies to establish the appropriate instructional strategies for high, medium and low mental ability levels of students with different learning styles in genetic concepts in Biology. The previous studies on Gallery Walks Strategy and Mind Mapping Strategy showed little or no concentration on moderating effects of mental ability and learning styles on senior

secondary school schools. The strategies have been used separately in different subjects. None of the researchers examined the combined effects of the two strategies in genetic concepts in Biology.

Based on this, the study, therefore, examined the effects of Gallery Walks Strategy and Mind Mapping Strategy on learners' performance in, attitude to and Science Process Skills Acquisition in genetic concepts in Biology.The moderating effects of mental ability and learning styles were also examined.

1.3 Objectives of the Study

The followings are the objectives of this research study:

i. To determine the effects of Gallery Walks and Mind Mapping Strategies on the students' achievements, attitudes and science processes skills acquisition in genetic concepts in Biology.
ii. To determine the effect of mental ability on the students' achievement, attitude and science process skills acquisition in genetic concepts in Biology.
iii. To determine the effect of learning style on the students' achievement, attitude and science process skills acquisition in genetic concepts in Biology.
iv. To determine the interaction effect of the Gallery Walks, Mind Mapping Strategies and mental ability on students achievements, attitudes, and science process skills acquisition in genetic concepts in Biology.
v. To determine the interaction effect of the Gallery Walks, Mind Mapping Strategies and learning style on students achievements, attitudes, and science process skills acquisition in genetic concepts in biology.
vi. To determine the interactioneffect of mental ability and learning styles on students' achievements, attitudes and science process skills acquisition in genetic concepts in Biology.
vii. To determine the interaction effect of Gallery Walks, Mind Mapping Strategies, mental ability and learning styles on students achievements, attitudes, and science process skills acquisition in genetic concepts in Biology.

1.4 Hypotheses

To guide the study, seven null hypotheses were formulated and testedat 0.05 level of significance.

Ho1: There is no significant main effect of treatment on students'

(a) Achievement in Biology

(b) Attitude towards biology and

(c) Science Process skills Acquisition in genetic concepts in Biology.

Ho2: There is no significant main effect of Mental ability on Students'

(a) Achieveme in Biology

(b) Attitude towards Biology and

(c) Science Process Skills Acquisiton in genetic concepts in Biology.

Ho3: There is no significant maineffect of learning style on Students'

(a) Achievementin Biology

(b) Attitude towards Biology and

(c) Science Process Siklls Acquisiton in genetic concepts in Biology.

Ho4: There is no significant interaction effect of the treatment and Mental Ability on Students'

(a)Achievement in Biology

(b) Attitude towards Biology and

(c) Science Process Siklls Acquisiton in genetic concepts in Biology.

Ho5: There is no significant interaction effect of treatment and Learning style on students'

(a) Achievementin Biology

(b) Attitude towards Biology and

(c) Science Process Skills Acquisiton in genetic concepts in Biology.

Ho6: There is nosignificant interaction effectof Learning style and Mental ability on Students'

(a) Achievement inBiology

(b)Attitude toward Biology and

(c) Science Process Siklls Acquisiton in genetic concepts in Biology.

Ho7: There is no significant interaction effect of treatment, Learning style and Mental ability on Students'

(a) Achievementin Biology

(b) Attitude towards Biology and

(c) Science Process Siklls Acquisiton in genetic concepts in Biology.

1.5 Scope of the Study

The study ascertained the effects of Gallery Walks and Mind Mapping Strategies on Students' Learning Outcomes in Genetic Concepts in Biology. The study covered SS2 Biology Students from nine Secondary Schools, in three Local Government Area of Kwara South Senatorial District. The Genetic Concepts that was covered includes; Meaning of Genetics and Heredity; Transmission and Expression of characters from parent to offspring; First Mendelian law; Second Mendelian law; Chromosomes the basis of heredity; Probability in genetics; Application of the principle of heredity in agricultural science and medicine. However, learning style and mental ability was also examined as the moderating variables.

1.6 Significance of the Study

The finding from this study is expected to upgrade students' academic performance and positive attitude to genetic concepts in Biology. The reports of this study would also, facilitate the implementation of objectives of Biology and national policy on education. The finding would instigate all the stakeholders in education; both private and public, to provide adequate instructional facilities and manpower to our Secondary School in order to assist students to develop their skills through Gallery Walks and Mind Mapping Strategies.

The results of this research work would contribute positively towards the curriculum planning, development and training of Biology teachers for better classroom effectiveness and provide informationto the science tutors on learner's behaviours such as learning style and mental ability towards their achievement in Genetic Concepts in Biology.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

In this chapter, a review of related literature wasdiscussed under the following theme: Theoretical frame work, Conceptual evaluation and Emperical evaluation.

2.1 Theoretical Frame Work

Recent discoveries in psychology and brain neurophysiology have led to many new and renewed theories of learning. Both Gallery Walks and Mind Mapping Strategies of teaching and learning have emerged from the constructivism theory of learning. This research is hinged on the following theories of learning:

a. **Lev Vygotsky Constructivist Theory of Social Development**
b. **Jean Piaget's Constructivist Theory of Development**

(a) Lev Vygotsky Constructivist Theory of Social Development (1896-1934)

Social constructivism theory opined that knowledge and improvement is an aggregate movement and that students are psychologically evolved with regards to socialization and training,,Vygotsky demanded for learning that occur in a real world and the involvement of which a portion of the psychological procedures that individuals bring into the study hall are questioning, anticipating, summing up and explainingSuch ideal involve critical thinking for solving problems in academics which has its foundation in project and inquiry strategies of teaching. Vygotsky (1978) advocated for more social constructivism which suggested that psychological advancement is impacted intensely by others and outside factor. He accepted that learners ought to use the contribution of others to assemble or build their own learning through communication encounters and that educators could encourage the learning.

Learning basically originates from companions, loved ones just as from other social sources.Vygotsky additionally accepted that students gain signs when they study, which they retain in their memory, this empower them to have the option to think autonomously, which is otherwise called 'self-regulation.Vygotsky hypothesis likewise consolidates cooperative learning, where learners gain from one another in their ProximalDevelopment Zone(PDZ)and are more answerable for their own learning(Vygotsky, 1978).Constructivist teaching fuses collaborativelearning and is

at times alluded toas top-down, where learners start with a muddled issue and tackle it utilizing fundamental ability and some instructor direction.

The constructivism idea is also represented in the illustrations bellow Figure 2.1- 2.3

Fig.2.1: Vygotsky's Constructivist Approach

Figure 2.1 shows that when learners are given some guidance / direction on what to do, they beginto make effort on scaffolding basis until they reach the zone of proximal development , where they are able to construct their own idea and knowledge based on their own experiences and relationships, and thus make sense of the entire world around them.

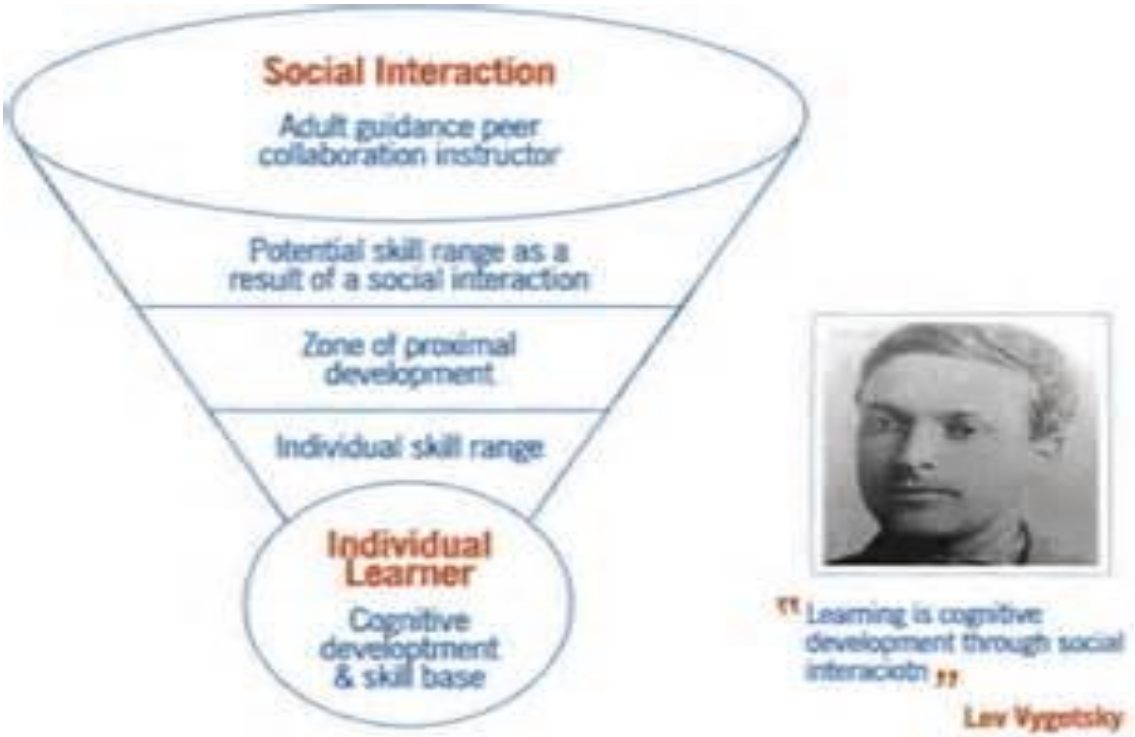

Fig. 2.2: Vygotsky'sEmphasis onSocial Interaction

Figure 2.2 shows that an individual learns as a self-contained person with limited mental cognitive growth and a diverse skills base that may pass a certain abilities range held by the zone of proximal developmenit. Meanwhile, when an individual interact with others andi work as part of a team, he grow stonger and gain new experiences and talents, all while being exposed to the possibility of social contact. This system allows collaborative efforts and peer assistance, which benefits both people and society as whole.

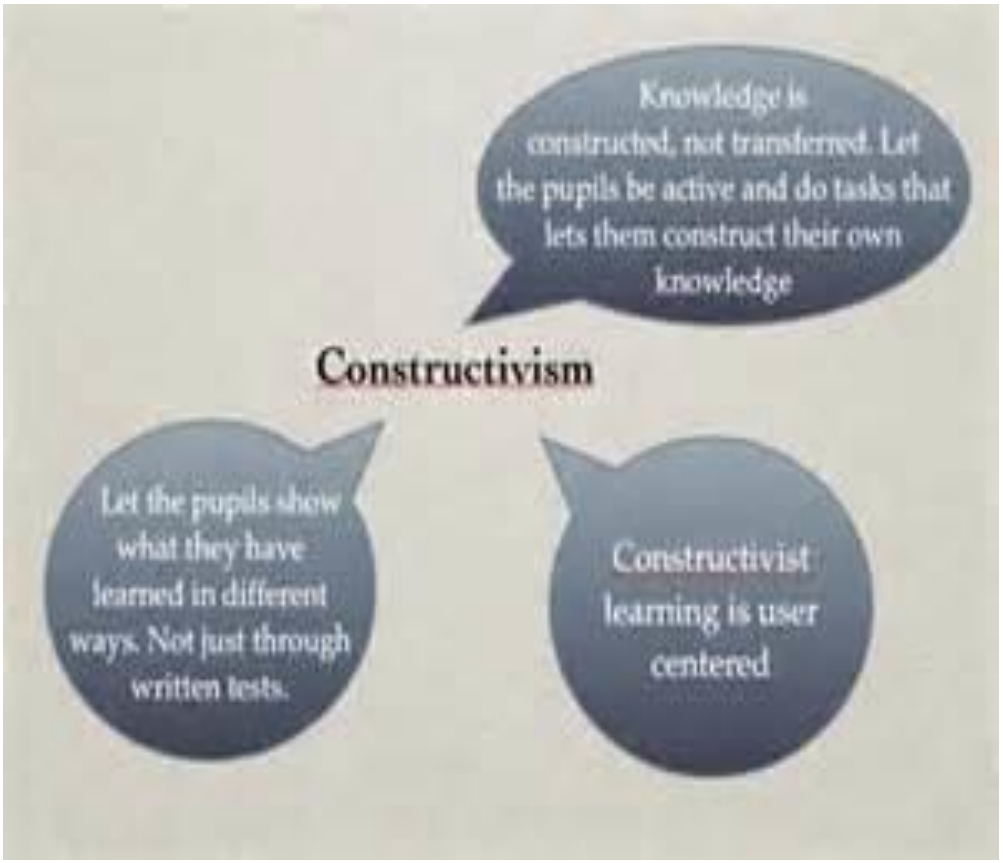

Fig. 2.3 : Vygotsky'sInstruction to Teacherson the use of Constructivism Approach

To explain Fig. 2.3, starting from the lower right side and rotating to the left side, the teachers are urged to make academic content delivery student-centered, in which the teacher provides little guidanceand students are encouraged to exploreby interating within themselves to develop their own personal ideas about subject matter. Students should be able to take an active role in class and complete project that allow them to build their own knowledge. Finally, students should be able to demonstrate their knowledgein a variety of methods other than written assessments. This is to allow for proper proper student engagement and presentation of inbuild talents with certain students excelling in drawing, Observing, classifying, measuring, inferring, drawing, recording, predicting identifying, calculating, graphing and experimenting rather than restriction to written tests and examinations only.

(b) Jean Piaget's Constructivist Theory of Development

Piaget's theory grounded on the possibility that a child that undergoes intellectual development can effectively and adaptively assembles intellectual designs, as such mental "maps" structure or organized ideas for comprehension and reacting to actual experience inside their current environment. Through progressive phases of scholarly improvement learners create scholarly designs that empower them to have a more prominent understanding of the world, in addition themselves. Piaget believed scholarly action to be a natural capacity. In his hypothesis, Piaget depicts the turn of events and variation of mental tasks or thought structures for instance checking, arrangement and so forth which progress through rich collaborations with the world. Mind Mapping in Biology will assist learners with advancing through such collaborations. Piaget's theory of conceptual change includes four phases of intellectual development.

Sensorimotor stage (birth – 2years old),

Pre-operational stage (age 2-7),

Concrete operation (age 7-11) and

Formal operations (Beginning at age 11-15).

Thinking is liberated from the real. Youths start to develop entire frameworks of conviction and can participate in more intelligent thinking like pondering on other's contemplations or taking part in self-reflection. In logical issues tackling, formal reasoning empowers youths to methodicallly control factors and reason about questions like mathematical factors. This phase of intellectual advancement can be useful to the learners in the development of mind planning as mind mapping will

assist students with making proof to the key ideas or recommendations to be learned and propose associations among new and past information. It significantly affects the thory and practice of training. It centers consideration on thought of formatively fitting training.

Implication of Piaget's Theory by Slavin (2005)

1. It emphasize the interaction of learners thinking, not its items. Instructors lay emphasis on the cycle that learners used to find the solution.
2. Recognition of the pivotal job of learners self started, dynamic contribution in learning exercises:- learners are permitted to find for themselves instead of the introduction of instant information.
3. A de-accentuation on practices pointed toward making learners grown-up like in their reasoning, the accept that exertion made to quicken children measure through the stages could be more terrible than no instructing by any means.

Acknowledgment of individual contrasts in formative advancement: Piaget's theory attests that children experience.

2.2 Conceptual Review

2.2.1 Classification of Instructional Strategies

A strategy refers to a way of doing things or a method used by a teacher to facilitate leraning. The different type of teaching strategies is practicallyunlimited; it will be very useful to discuss the term of classification of teaching strategies such as:

(1)Teacher Centered Strategy

(2)Students Centered Strategy.

2.2.1a Teacher-Centered Strategy

These is a strategy in which the teacher teaches the concept to the students without involving them that is the teacher is the only active participant in the class and the students are passive in the course of the teaching. The strategies that fall to these categories are lecture, demonstration, and storytelling.

(a) **Lecture** is an educational plan or a speech given before students**.** Lectures are much contravened as a teaching method for it is mainly a one-way strategy of communication and contrasted to the principle of active learning procedure.

(b) **Demonstration** Is the process of teaching through examples or experiment. The method involve the students personally relate to the presented information.

(c) **Story telling** Is the improvised or embellished presentation of events in phrases, pictures, and sounds.. It provides a realistic context for content.

(d) **Direct instruction** Is an educational philosophy that asserts that the most successful method of teaching is by explicit, guided directions**.**. It helps to learn concepts and skills.

2.2.1b Students Centered Strategy

Students centred strategy (or kid focused learning), is a technique to instruction zeroing in on the necessities of the learners, as opposed to those of others associated with the instructive cycle, for example, educator and organization is a two way correspondence methodology among instructor and learners in the shared journey for truth. There are various procedures in this segment. They are recorded and clarified underneath:

(a) Cooperative Learning - includes organizing classes around little gatherings that cooperate so that each gathering individual's achievement is subject to the gatherings achievement. In this way training procedure advances dynamic investment, singular responsibility, learners capacity to work agreeably and improvement of social abilities.

(b) Discussion Methodology are full of feeling in getting the students to think helpfully while connecting with the remainder of the gathering. Conversation may happen in the study hall or on the web.

(c) Inquiry based Learning is a demonstration of looking for truth, data or information through addressing. It is learner focused and educator guided instructional methodology that draws in learners in exploring genuine inquiries that they pick inside a wide topical system. This technique shows critical thinking, basic reasoning abilities and disciplinary substance.

(d) Project based Learning is learner focused methodology of instructing which include a wholehearted deliberate movement continuing in a social climate. The procedure has the accompanying advances causing circumstance, determinations of the issue, arranging, execution, assessment and revealing and recording.

(e) Role Play is the cognizant carrying on and conversation of the job in a gathering. In the classroom, a difficult circumstance is momentarily carried on so the individual student can relate to the characters. The procedure manages taking care of issues through activity.

(f) Discovering Procedure is an instructional strategy that urges student to play a more dynamic part in their learning interaction by responding to a progression of inquiries or tackling issues intended to present an overall idea. The technique increment maintenance of material on the grounds that the learners arrange the new data and incorporates it with data that had just been put away.

(g) Scaffolding is an instructional procedure, related with the zone of a proximal turn of events, in which an educator gives individualizes instruction steadily thereby improving a student capacity to expand on earlier information.

(h) Case Studies System is an instructional approach that comprises of giving the learners a case placing them in the part of a leader dealing with an issue.

(i) Brainstorming is an interaction of unconstrained speculation utilized by an individual or by group of individuals to create various elective thoughts while conceding judgment.

(j) Field Outing is a gathering outing away from the ordinary climate for that hand insight of a memorable site or spot of uncommon interest.

(k) Situation and Gaming alludes to a progression of instructional materials that utilization components structure recreation and game. Recreating and Gaming should be possible with tabletop games, PC helped table games or completely automated conditions.

(l) Mind mapping is a methodology of gathering data made by proposed by Tony Buzan. It is broken to help your profitability, imagination and memory. A mind map is a visual reasoning tool that can be used in a variety of psychological capacities, including memory, learning, creativity, and evaluation.

(J) Gallery walk methodology is a conversation system that gets learner out of their seats and effectively engaged with integrating significant science ideas, composing also, and public talking.

2.2.1.1 The Objectives of Biology

Sallau, Abubarkar and Sani, (2018) defined Biology as the science of life. Biology has contributes massively to the innovative development of nature. This incorporates medicine, pharmacy, horticulture, biotechnology and nursing etc. They further expressed that the investigation of Science in senior secondary school can furnish learners with helpful ideas, standards and knowledge that will empower them face the difficulties when they graduate from university. Biology in senior secondary school is

offered for the three-years. In Nigeria educational curriculum of today, biology is not a mandatory subject for students in secondary schools, however in Kwara State biology is one of the subject that learner should pass before he/she can be elevated to SS three class (State advancement assessments that includes the accompanying subjects: English language, Mathematics, Biology and Financial aspects).

Besides, Kwara State government has make Biology mandatory for their students. The points offered in biology course inside 3years it set up the students for advanced education in any of the natural science related course. The senior secondary School as indicated by the Public Approach of Training 2008 will be thorough with a main subjects assigned to expand students "knowledge and standpoint" (Sharon, 2008). The senior secondary school Science educational program is one of such educational program materials. The Science educational plan at the mandates of the National Government is for the cultural and individual turn of events and has its cardinal destinations.

Goals of Science in Nigeria Secondary Schools

To get ready students to secure:

1. Satisfactory laboratory and field abilities in Science.
2. Important and applicable information in Science.
3. Capacity to apply logical information to regular daily existence in issue of individual furthermore, local area wellbeing and horticulture.
4. Sensible and useful logical elevation FRN (2008)

In achieving the expressed goals, the content and setting of the educational curriculum place students on field studies, guided revelation, research strategies and improvement of science process abilities alongside theoretical reasoning. The educational program (curriculum) is planned to give a modern day Biology course which address the issues of the student and the general public through significant and practical substance, strategies, methods and applications. It covers the significant themes of:

1. Association of life
2. Organism at work
3. The organism and its environment
4. Continuity of life.

These themes are directly pertinence to the general public and the student.th biology curriculum was arranged using the spiral method so as to make continuos and span through the senior secondary school. (NERDC, 2009).

2.2.2 Studies on the Gallery Walks Strategy (GWS)

A Gallery Walks procedure is a conversation methodology that makes student to be active and effectively associated with combining significant science ideas, composing and public speaking (Mark, 2006). Research on learning underpins the possibility that conversation is better than conventional way for it advances higher-order thinking abilities including investigation, assessment and synthesis (Johnson and Miyhten, 2005). GWS are valuable since they advance basic reasoning correspondence and practice with basic assessment of new data as students grapple with difficult concepts that may bring confusions. (David *et al,* 2015).

Nwanekezi,*et al* (2018) stated that Gallery Walks Strategy empowered dynamic interest, cooperation and development of critical thinking abilityof students in fundamental science class. The Gallery Walks Strategy gives such a chance, permitting learner to solve intriguing question. Report is submitted at the end of Gallery Walks and the educator has the alternative of expanding this action with composed tasks. Team - building abilities are underscored, as groups need to sort out remarks composed from an assortment of viewpoints and arrive at agreement with respect to which comments are generally convincing.

Preparation for Gallery Walks

To prepare for the Gallery Walks, participants must create posters with these seven parts (John, 2013).

1. Project Title.
2. Grade level or class
3 Project idea (Summary of main issue/task/purpose).
4 Driving questions
5 Content (Summary of key standard/topics).
6 Major products (What students will create).
7 Public Audience (who will see and hear presentation or use product).

John, (2013) formulated a table that comprises the simple stages and time Involved in the presentation of Gallery Walks Strategy in the classroom. Table 2.1

Table-2.1 : Title-Table showed the stages and time of Gallery walks Strategy.

S/N	Stage	Time
1	**Setup: -** Hang posters and distribute sticky notes	2 Minutes
2	**Roles:-**Significant content, driving questions, in depth inquiry and public audience.	2 Minutes
3	**Gallery Walk and Feedback: -** Silently record feedback on sticky notes using specific terminology such as "I like and I wonder" Give one "I like" and "I wonder per poster.	20 Minutes
4	**Reflection: -** In your journal reflect on the feedback and discuss the gallery walk.	5 Minutes
	Total	30 Minutes

Variant of the Gallery Walks Strategy.

1. Gallery Run
2. Computer Tour or Gallery Computer

Steps involved in Gallery Walks strategy.

1. Create and post questions: -the facilitator structures questions on a topic to be treated.This questions depends on the number of students in the class. For example, where there are thirty students in the class six questions will be structured and each question on a sheet of paper.
2. Group the students, assign roles, and stress team building: - After explaining the procedure to the students on how to use gallery walk, the instructor will group the students into three to six groups depending on their population, a group leader, recorder and will be appointed.
3. Assign stations and begin comments: - Direct teams to different discussion stations.
4. Rotation: - here the students move round at each station they add up to the comment left by the previous group. The teacher moves round the stations to clarify issues, solve problems that may arise and test students knowledge.Fig. 2.4; shows the Skeletal structure of the students rotating in Gallery walks strategy.

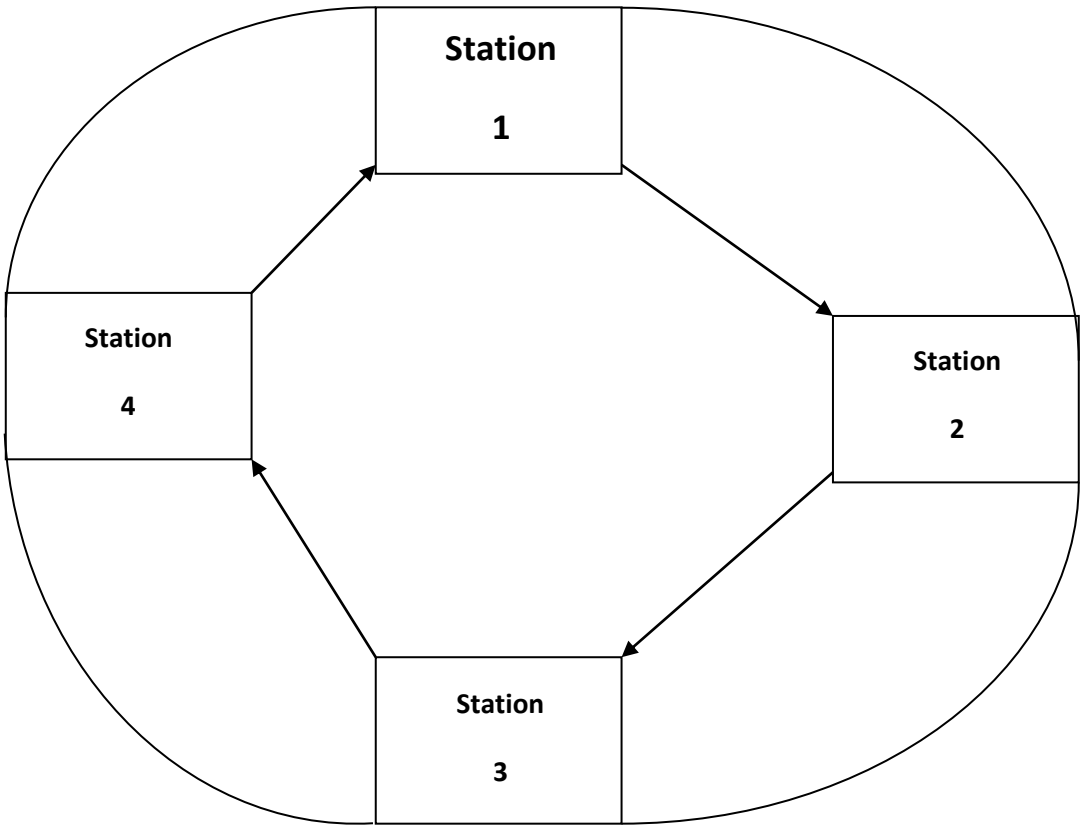

Figure 2.4; Skeletal structure that shows the students rotation in Gallery walks strategy

Source-http;//;www.rsu.edu//resources/federalprogs/programs/support/sss.Jpg 2004

Description of figure 2.4

Station 1 : is the permanent position for group 1 members before and after rotation.

Station 2 : is the permanent position for group II members before and after rotation.

Station 3 : is the permannet position for group III members before and after rotation.

Station 4 : is the permanent position for group IV before and after rotation.

5. **Begin Oral presentation: -** After each has visited each station report is presented within the spac of five minute. During the presentation, the teacher make corrections where there are mistakes and add up where necessary.

Advantages of Gallery Walks Strategy

1. It aids memory and recognition.
2. It encourages students to engage in physical activity and have fun in the classroom.
3. It improves time management, eliminates uncertainty about content presented on other teams' items, and improves student ownership/comprehension of material, as well as reducing stress levels for both students and facilitators.
4. It seemed to de-emphasize memorization of the correct response to questions, and students seemed to benefit from it. It removes boredom which makes learning uninteresting.
5. It improves public speaking skills.
6. It develops team building and listening skills among students.

2.2.3 Studies on the Mind Mapping Strategy

A Mind Mapping is a visual outline used to record and put together data in a manner which the cerebrum (brain) discovers and simple to measure. Thoughts or realities are spread out around a focal topic with the goal that you can obviously 'see' their stream across various levels. In contrast to straight techniques for recording data, a MP doesn't depend on a lot of composed content however rather utilizes lines, images, catchphrases, shading and pictures all as indicated by straightforward, cerebrum well disposed ideas. The procedure was designed and advocated by Tony Buzan during the 1970s and is presently utilized by a huge number of individuals around the world.

Mind Mapping is worked around a few key components, which have been demonstrated to assume a significant part in releasing your reasoning limit. Mind Mapping was characterized by Buzan, (2000) as an outflow of Ecstatic Thinking and is hence a component of the human brain, and an incredible realistic strategy, which gives a widespread key to opening the capability of the cerebrum.A Mind Mapping is a visual reasoning instrument which is used in all psychological capacities, particularly memory, learning, innovativeness and examination. Mind Mapping is a cycle that includes a destructs mix of symbolism, shading and visual-spatial course of action. Mind Mapping can be drawn by hand or utilizing programming, for example, Mind Mapping.Tony Buzan suggested a data-gathering technique called Mind Mapping.It's been broken to aid your productivity, creativity, and memory.

2.2.3.1 Description of Mind Mapping

Tony Buzan built up a framework that can be used by individual in the course of learning. Fundamentally, he developed a framework that helps to quit any pretense of demanding utilizing the conventional techniques for inventive personalities yet rather he pointed toward mirroring the usefulness of the human brain. These guides permit students to arrive at the incredible capability of their brain without any problem. MindMapping permit individual to aggregate the ideas, re-group again and look at the ideas. The development of the ideas and the incorporating of it together in new cluster regularly uncover new thoughts. Mind Mapping is a ground-breaking realistic strategy which targets utilizing the mind with full limit (Buzan and Buzan, 2005). Simultaneously, researchers found out that Mind Mapping helps in the development of thinking abilities. Recently, investigations on Mind Mapping have been carried out on different students with different outcomes.

Mind Mapping gives a viable investigation when applied to written material". Goodenough and Woods, (2002) in his research work discoverded that there were numerous impacts of this investigation. Students’view of Mind Mapping was "fun, fascinating, and a persuading way to deal with learning". Also, learners liked to utilize Mind Mapping in an individual circumstance instead of a group’s situation since they could communicate their own thoughts for their own importance. Mind Mapping is significant, successful and valuable for learners to construct their comprehension of natural ideas in a manner which can assist the students with being viable. Designs organizers helps learning by giving a chance to visual boosts, conceptualizing,

recording data in none straight style, appraisal, checking understanding, critical thinking, elaboration, making analogies, note taking, summing up, showing grouping of occasions and other inventive methods of guidance.

Trevino, (2005) said that Mind Mapping Strategy enables students to retain information for a longer time. Buzan, (2005) and Keles, (2011), believed that Mind Mapping encourages learners to see the associations among the pieces of information. Mind Mapping empowers learners to make significant connection among the pieces of information introduced. Mind Mapping improvedstudents learning outcomes and backing the development of conceptual understanding.

Uses of Mind Mapping

Mind Mapping is helpful for:

• Conceptualizing - individually, and as a group.

• Summing up data, and notetaking.

• Solidifying data from various research sources.

• Thoroughly considering difficult issues.

• Introducing data in an organised manner that shows the general design of your subject.

• Learning, recollecting and review data.

It likewise stimulate significant learning ratherthan retention (Buzan, 2005) The idea of Mind Mapping empower educators to discover better approaches for examining ideas with students and recognize inaccurate learning process. Adodo, (2013) detailed that One of the fundamental points of interest of Mind Mapping is that they take into account simple acknowledgment of visual images. Also, they can more readily clarify ideas that words can't clarify, they are learnercentered, they inspired educators-learners communication and they assist learners with holding information for a longer time.

On the other hand, the major weakness is that learners who are new to Mind Mapping may experience issues in understandingcomplex maps.Also; students may experience difficulty in drawing their own Map.

Types of Mind Mapping:

Usually, there are three regular kinds of Mind Maping dependent on the researchpurpose: They are:-

1. Library Mind Mapping: - They are utilized to follow data.

2. Presentation Mindmaps: - They are utilized to introduce thoughts or ideas.
3. Tunnel Timeline Mind Mapping: - They are utilized to put together and construct a project plan.

1. **Library Mind Mapping-**

Library Mind Mapping, otherwise called the reference Mapping, are utilized to put together data outwardly; numerous pieces of data or points can be examined effectively without losing any part. Thus, a Mind Mapping begins with various broken thoughts or subjects or ideas and afterward, these thoughts or ideas are coordinated together in a tree structure. This construction will in general form a linkage between related thoughts and sort out how the principle theme crosses together. The library Mind Mapping center around the thought, point or ideas. So it begins with fundamental thoughts (subject or idea).

Library mind map can be utilized to accomplish the following:-

1. Explore a particular theme or idea and the connected thoughts around it.
2. Organize data about a particular project or theme or idea in a visual technique that can be effectively followed during the conversation

2. **Presentation Mind Mapping -**

This kind of Mind Mapping is utilized to introduce a progression of thoughts or ideas like recounting a story or following a source of inspiration measure. These mind mapping will in general outwardly present the thoughts to follow the means and the data identified with each progression. Unlike the reference maps the introduction Mind Mapping is intended to follow the conversation and imagine its particular stream as opposed to controlling the session through the gathered thoughts. This strategy centers around the participants instead of the subjects. This sort of mindmap can be utilized to accomplish the accompanying.

a. Present a particular consumer conduct when utilizing an item and the steps that the buyer continued in for example purchasing an item or buying in to a site.

b. Training sessions; when the student needs to follow a particular flow of information for example power point introduction.

c.Discuss a contention or a circumstance and the means dependent on the present circumstance.

3. Planning Mind Mapping-

When making arrangements for a particular task or browsing various activities during the undertaking progress, the planning Mind Mapping can be utilized to introduce different activities and the relations sub-activities, These can be considered typical from various arrangement. This kind of Mind Mapping can be utilized for activity plan or undertaking methodology, or critical thinking.

This kind of Mind Mapping can be utilized to accomplish the following:-

Plan project and build project technique that can be carried out through explicit ways.

Solve issues through setting the quest for solution and possible strategies for tackling the issue during brainstoming session.

Table 2.2 Differences between Mind Mapping and Concept Mapping

S/N	MIND MAPPING	CONCEPT MAPPING
1	It center around just single word or though	It interface words or thoughts. It has text marks on their interfacing lines/arms.
2	It depends on outspread orders and tree structures indicating relationship with a focal overseeing idea..	It depends on associations between ideas in more different examples.
3	Less formal and organized	Formal and firmly organized
4	It lays emphasizes on diagrams and picture and recall of association.	Utilize various leveled design and expressions to lay comprehension of connections.

Advantages of Mind Mapping.

Mind Mapping is a basic, functional device for improving your imaginative reasoning, arranging and critical thinking capacities. It will help you.

1. Generate more thoughts: - Mind Mapping permits you to begin rapidly and create more thoughts in less time. You don't need to alter or arrange your idea.

2. Make linear association: - Mind Mapping permits you to denote a gigantic measure of data in a generally little space. It encourages us see associations among things that may have appeared to be totally discrete.

3. Improve your memory: - Recalling your material turns out to be a lot simpler tones, pictures and keypoints.

4. Use your entire brain: - the use of the half of the brain is a waste of time and something terrible. Mind Mapping causes you to fortify your left brain via preparing you to search for the most fundamental key words. (At these are time). It enhances the correct part of the brain by making the student to represent information with correct colours.

Things to consider when creating Mind Mapping: The following things should be put into consideration when building Mind Mapping. They are; maps central idea, picture; Branches; colours; keypoint; Pictures.

STEPS ENGAGED WITH MIND MAPPING

STAGE 1 –CREATE A CENTRAL IDEA: -

The first stage addresses the subject/idea that willbe investigated. Your cental idea ought to be in the center of your page and ought to incorporate a picture that addresses the Mind Mapping's subject. This draws consideration and triggers relationship as our brain react better to visual motivations.

STAGE 2 – ADD BRANCHES TO YOUR MAP

Adding branches is the next step in implementing the creative concept. The key topics are the main branches that branch out from the center picture.By attaching small branches to each topic or theory branch, you can dig deeper into it.The Mind Mapping has the benefit of allowing you to put more branches.Keep in mind that the layout of your website is significantand will work out normally and your cerebrum uninhibitedly draws new affiliationsbetween them..

STAGE 3 - ADD KEY WORDS

You can integrate a main thought if you add a branch to your Mind Mapping.The use of a single word per branch is a common practice in Mind Mapping.As opposed to using several terms or phrases, sticking to a single word creates a larger number of connections.Single word per branch additionally functions admirably for arranging information into cone focuses and themes. The utilization of expressions causes associations in your mind and assists you with recollecting a huge measure of data without any problem.

STAGE 4 - COLOUR CODE YOUR BRANCHES

Mind Mapping inspiresintellectual thinking by bringing diverse critical thinking skills, from rational and mathematical to creative and extraordinary.Color coding your Mind Mapping is an example of brain thinking.Color coding connects the visual and logical; allowing the brain to take fast mental shortcuts.You can use the code to sort, function, dissect, and categorize more data. More relationships that haven't been discovered recentlyIn contrast to simple, monochromatic images, color often makes pictures far more engaging.

STAGE 5 – INCORPORATE PICTURES

Pictures have the ability to pass on substantially more data than a word, sentence or even an article. They are prepared in a flash by the brain and go about as visual improvements to review data. Pictures are a widespread language which can defeat any language hindrance. We are characteristically instructed to handle pictures since early age. It has been observed thatbefore children gain proficiency with a language they imagine pictures in their brains, which are connected to ideas. Consequently Mind Mapping amplify the incredible capability of symbolism.

2.2.4 Studies on the Conventional Strategy.

According to Suleiman (2011) conventional strategy is a teaching strategy that combines oral presentation with doing to communicate process, concepts, and ideas. It requires the teacher to deliver preplanned lesson to the learners with instructional materials. Conventional Strategy as been seen as a strategy that does not tend to foster critical thinking, creative thinking and collaborative problem-solving. Olatoye and Adekoya (2010) reported that conventional strategy is the most widely used form of teaching strategy. This is supported by NTI, (2008) that reported that the approach to teaching in Nigerian is teacher-centered (Conventional Strategy) which implies

that teacher does all the talking and the learners do all the listening. It was noted that the traditional or conventional strategy is characterized by the following (NTI, 2008); Use of lectures to provide critical information; Unspecified or vague objectives; A constant instruction-set pace for all students; Delayed feedback to students about his performance; Emphasis on instructor behavior rather than students' behavior; Evaluation which is infrequent over large sections of materials and for the purpose of assigning elative standing rather than for remediation; Ministerial responses of students to the instructional materials.

2.2.5 Students' Attitude towards Science

Attitude is not natural or intrinsic. Contemporary psychologist keep up that attitude are learned and are coordinated through encounters as children create. Besides, a child's mentality can be changed through experience. Instructors and guardians have the best impact on science perspectives (Martin *et al,* 2010). Attitudes are dynamic consequences of encounters that go about as order factors when a child goes into new encounters. Therefore, attitude conveys an enthusiastic and a scholarly tone, the two of which lead to making choices and framing assessments. These choices and assessments can make a child set needs and hold various inclinations.Extensive research has shown that an individual's attitudes arelearned, instead of being acquired. The effect of learners' disposition toward science is unbelievably significant (Farahnas, 2012).

Attitude as a factor could be seen as the entirety of a person's tendency towards item, organization or thought. Kerlinger according to Wilson *et al,* (2009) believed that it is a coordinated inclination to think, feel, see and act toward a referent or psychological item. Attitude could be taken in or shaped and gained from individual from the family, instructor and friends (Huitt, 2011). The student gain so much from the educator's manner to shape attitude towards learning which could emphatically or contrarily influence his learning. Educators are good examples to the learners in light of the fact that as they act, so do the learners show such demonstration or conduct. It is grievious that little did numerous educators understand that the manner in which they handle the educating of science as a subject, act and team up with the learners as science teachers could make critical effect on student's achievement. A couple of teachers seem to have made negative attitude towards showing the learners this

subject (science) that is very vital for human living. This may have been at risk for the negative disposition made towards learning science by the learners.

Attitude is a variable that impact the learning outcomes of students' attitude to learning may possibly be good or bad. Soltani and Nasr, (2010) in their research work found out that statisistically student's attitude do not predict achievement in Biology. The idea of attitude isn't simply basic to social psychology science yet in addition to the psychology science of character and that of learning as a rule. The idea of attitude emerges from endeavor to represent noticed guidelines in the conduct of individual people.

Attitude is inclinations of ordered arrangements of items or occasions and to respond to them with some level of assessing consistency. Science teachers have battled with characterizing science attitude and separating among attitude, convictions, and qualities (Martin *et a*l, 2010). The idea of "attitude" is characterized extensively as utilized in the science instructive writing. Oliver and Simpson, (2008) characterize attitude as how much students likes science. Attitude can be seen as having three primary segments: psychological, emotional and social segments Salta and Tzougraki, (2008). Osborne, Simon and Collins, (2003) have recognized numerous highlights that impact one's attitude: sex, primary factors (for example financial class), study hall/instructor, and educational plan.

2.2.6 Students' Science Process Skills Acquisition

Science process skills (sps) are special skills that simplify learning science, activate students, develop students' sense of responsibility in their own learning, increase the permanency of learning, as well as teach them the research methods (karamustafaoglu, 2011; Ramesh and Patel, 2013). Yadav and Mishra, (2013) defined the science process skills as the sequence of events that are engaged by researchers while taking part in scientific investigations. According to Mutiu and Temiz, (2013) define science process skills are the basis for scientific thinking and research.

Science Process Skills is the fundamental and incorporated abilities improve the reasoning and thinking capacities. A process skill in science for learners underscores the utilization of our five sense organs. The idea of doing science is vital for acquiring

science process skills among students. The American Association for the Advancement of Science (AAAS) identified fifteen of these skills (Richard, 2013) These skills are:

i. Observation
ii. Measuring
iii. Classification
iv. Experimenting/Controlling of Device
v. Communication/Recording
vi. Predicting
vii. Inferring
viii. Counting/Numbering
ix. Using space/time relationship
x. Questionnaire
xi. Controlling factors
xii. Hypothesizing
xiii. Defining operationally
xiv. Formulating models
xv. Interpreting information.
xvi Labeling

Importance of Science Process Skills Acquisition

Science process skills are foundation for the concepts formulation, during the school education students need to understand basics of science. Science is basically observable and verifiable therefore process approach is more scope to use their mind and hands through which students can get concrete experience (Ramesh and Patel, 2013). Ramesh *et al*, (2013) pointed out that science process skills foster significant increase in subject matter understanding and science content knowledge, arguing that science content and science process skills should be taught together as they complement each other. Developing attitude towards science among the students is

one of the objectives of science teaching in schools, acquisition of science process skills can promote favourable attitude towards science. According to Ramesh *et al* ,(2013) science process skills involves interest, thoughts and action that make the learner to motivate intrinsically, understand the scientific concept clearly and acquire the skills proficiently therefore cognitive, affective and psychomotor domains of an individual is strengthened.

Past researches on science process skills (SPS) showed that out of the 15 science science process skills suggested for science educational programs, about 70% of the learner sactually experience challenges in gaining them and furthermore; gender has no impact on learners experienced problems (Jack, 2018 and Jack, 2013). Also, research showed that there are different elements that impact the achievement of science process skills acquisition, for example, science measure abilities. Jack, (2013) believed that the educator assumes a significant part in getting the hang of, including the securing of science measure abilities. In spite of the fact that schools have little effect, that is just roughly 10% in learners'accomplishment; the main factor influencing students' learning is the educator.

Adegoke, (2015) stated that the pertinence of science process skills acquisition in science instruction is that it includes learners "doing science". Yet, in spite of the significance of science to human kind and the effort of reserachers to enhance its teaching and learning, the learning outcomes of students in the subject remainpoor in Nigeria. Among the components that have been distinguished students' disposition (Yara, 2009), poor techniques and inadequate research facilities (Olagunju, 2006). Awolere, (2002) affirmed that in spite of the acknowledgment of the fact that science subject is very important, it is clear that reports'actually shown that students attitude toward the subject is poor along these lines resulted into low aquisition of science process skills. Science is additionally taught in many schools as a heap of deliberations without pragmatic encounters because of inadequate facilities in the laboratory. This has make learners to have poor science process skills acquisition which obviour in students' performance in external examinations (Jack, 2013)

2.2.7 Students' Learning Styles

Learning style refers to the ability of learners to perceive and process information in learning situations (Rajshri, 2013). Learning styles are the ways

that people learn or process information. There are seven types of learning style.

The Seven Learning Styles

1) **Visual (Spatial) –** Prefer using pictures, images and spatial understanding
2) **Verbal (Linguistic) –** Prefer using words, both speech and writing.
3) **Physical (Kinesthetic)** – Prefer using body, hand and sense of touch.
4) **Aural (auditory-musical**) - Prefer using sound and music.
5) **Logical (Mathematical) -** Prefer using logic, reasoning and systems
6) **Social (Interpersonal)** – Prefer to learn in groups or with people
7) **Solitary(Intrapersonal)** – Prefer to work alone and use self-study.

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Table 2.3: Title –Showed the Description of Walter Burk & Colleagues learning modalities

S/N	VISUAL	AUDITORY	KINESTHETIC/ TACTIL
1	Picture	Listening	Body movements
2	Shape	Rhymes/chant	Gestures
3	Sculpture(visual media)	Tone	Object manipulation
4	Paintings(Display)	Summary/repetition	Positioning (Tactile)

Source-lumenlearning.com (2017)

Barbe and partners revealed that quality of learning methodology can happen freely or in mix (albeit the most regular qualitative methodology, as indicated by their research, are visual or blended) and this can change over time with advancement in age. There is no privilege or erroneous path concerning the learning style. A couple of individuals may find that they learn best when taught with a certain goal in mind, while others may track down that such way is jumbling and difficult to fathom. The different ways or approaches to manage learning are to use various styles that individuals may even join different parts of a few styles.

Regularly individuals begin to build up their own learning styles at an early age. It is similarly significant that educators and teachers take the different learning styles into thought when preparing their lesson plan and while training individuals in their classes. Guardians of young children ought to likewise consider what their children learning styles are and utilize this to help them in learning and joining home work. It is significant for individuals to find what their own personal preference are with regards to learning, as it will help them not just in their schooling in school but additionally in day to day life. Since individuals keep on learning throughout lives, there might be times when it becomes necessary to discover some new information which forms part of their carrier or for other individual reasons. In these circumstances, it may be useful to know and apply one's best learning style. In spite of the fact that there are different diverse learning styles, the most common one as stated by Madison, (2016) are:- Visual, Auditory and kinesthetic.

1. Visual Students (V)

Visual understudies are people (understudy) who learn best by using their feeling of sight. In a homeroom condition, visual understudies often sit toward the front of the study hall, where they can have the best viewpoint on the point that is being educated. They learn best with presentations, for instance, slide show, video layouts, charts and pictures. When attempting review things, it is helpful for visual understudies to imagine the materials. Portrayal is also helpful when composing an assessment or a test, as such an understudy will benefit by envisioning notes or graphs that they used while perusing or that were utilized in class.Colourful highlighters are a significant tools for the visual student, as taking significant notes, expressions, or sections is a valuable methodology. Another helpful methodology is shading colour. Visual students should endeavor to stay away from visual interruptions when studying.

Visual student have eyes for size and shape, they should figure out how to take serious notes, since they will in general fail to remember expressed words and thoughts. Several educators and teachers will compose keywords on the writing board or overhead projector. Albeit the students really see the words, visual students have preference for visual aids without words. i.e pictures, pictures, models and articles, Carter proposes that visual/spatial student ought to.

When and where applicable use graph and delineation.

Highlight the key point, thought or occasion and the fact that help those points, thoughts or occasions, ensure they see how all are associated together.

Draw arrow to interface or connect ideas or thoughts.

Colour-code your notes by point, idea or thought.

(2) Auditory Students (A)

For the hear-able understudy, hearing is their most noticeable asset concerning learning. Hearing things reiterated is helpful for such an understudy. When scrutinizing, books on tape or presenting for all to hear will be more helpful with respect to holding information than examining to oneself. Talks are ideal for auditory students, and study group are additionally of advantage. At the point when alone, it is useful to audit materials by talking out loud. With the legitimate endorsement from one's teacher, recording one's exercise and playing it back during study time might be of extraordinary advantage.

(3) Kinesthetic (tactile) Students (K)

For certain individuals learning are least requesting when they can really move or contact the material that is being utilized. Such learning is called Kinesthetic/sensation learning. People who are material/sensation understudies do best when they are being told with an extra elaborate philosophy that grants them to contact and associate actually with what is being educated. These sorts of understudies do well when working in a laboratory type environment and improve in genuine study hall settings versus online classes.

2.2.8 Students' Mental Ability

Mental ability depict the level at which an individual learnerlearn, gets guidance and takes care of issues or is a degree at which individual student learn and assimilate ,comprehend instruction and construct knowledge in their own way to tackle problems that comes on their way(s). Yoloye, (2004) defined mental ability as

genetic, cognitive, Physiological, nutritional and social factor as well as acquisition of skills all taken together to decide ability.Science Education Researcher categories learner use Australian Council for Education Research (ACER) instrument to perform into three i.e.high, medium and low ability.

Awolere, (2015) reported that an individual learner who has a high mental ability to cope with a task excel in a subject while the learner with low mental ability perform worse in the subject. Learner with low mental cognitive can reshape /improve through constant training and motivation. Mental ability influence attitudes for there is tendency for a student that had high mental ability to develop positive attitudes towards science (Biology) while the students with low mental ability will certainly develop negative attitude towards science (biology). While students with low mental capacity will surely create negative attitude's towards (Biology). Science is bound to impact student's achievement in science subjects than affecting their disposition (attitude).

General mental ability is a considerably huge determinant of individual differences in executing an academic work. Current exploration on broad knowledge has improved legitimacy speculations pointed toward determining the results of education, word related preparing, and work execution. Mental capacity has been found to impact learners in science (Biology). The universal goal directing the thought of mental capacity is that it has ability to differentiatebetween high and low capacity and show connection between specific capacities of mental capacity measured by learning outcomes of students. Moreover, presentation required on various mental capacity tests, for example, capacity to apply information to tackling issues, capacity to control conceptual ideas and connections and trial of language capability are connected to execution in school learning. In addition, estimation of intellectual abilities is a proportion of mental capacity of the students. Likewise, as referred to by Adeoye, (2011) that realizing the insight level of students will, to a certain degree, decide how much the student will accomplish from a skill.

2.2.9 The Genetic Concepts

Genetics is a coined word, gotten from the Greek root, which means to be conceived and be born. Genetics is the study of gene, hereditary variation and heredity. Tamarin, (2007) said that genetics is a science which tries to represent the similarities and contrasts displayed among living beings related by descent. Parents transfer

characteristics to their young through gene transmission. Geneis situated on chromosomes and comprises of DNA. Chromosomes contain explicit instruction for protein combination; children acquire them from their parent. Genetics is a branch of biology that study heredity, variation, functions and behaviours of genes. The sub theme found under genetics as highlighted by Ramalingam, (2007), include: principles of heredity, the transmission of inheritable characters from parents to their offspring via genes, and variation; differences that occur within the individuals of a specie.

The principles of heredity are used mostly in hybridization technology, genetic engineering, crops and animals breeding, counseling for geneticdisorders and Rhesus factor, genetic therapy and so on (Ramalingam, 2007). Global collaboration on Human Genome Project is evidence that international community has place importance on genetics. The primary objective of Human Genome Project is the analysis of human genes in which mutation will lead to disease. The recommendations from Human Genome Project could promote advances inprevention, diagnosis, and provision of therapy of genetic disorders (Lawa, 2011). Despite the numerous applications of genetics in particular and Biology In general to all areas of human endeavuors, it is unpleasant academically to note that students' performance at the school certificate level in Nigerian secondary schools is progressively decreasing.

2.3 Empirical Review

2.3.1 The Gallery Walks Strategy and Students' Achievement.

Exhibition gallery walks is a conversation method that gets learners out of their seat and into dynamic activities (Taylor, 2001). It empower other and numerous ways to deal with issues, since learners are presented with different type of conversation at a "Station" (Taylor, 2001)

Nwanekezi, Walele and Eruchi, (2018) explored the impacts of Gallery Walks teaching strategy on the learning outcomes of learners in basic science ideas in Rivers State. Pretest, posttest experimental design was adopted for the study. One hundred and twenty junior secondary school students were involved in the study. These students were randomly sample and divided into treatment group and control group. The students in experimental group were exposed to Gallery Walks teaching strategy while the control group was taught using conventional method of teaching.

It was observed that the treatment group nperformed better than the student in the control group. Therefore it was suggested that Gallery Walks should be adopted and utilized in the teaching and learning of science. Since it give room for dynamic support of learners, empowers coordinated effort, advances the utilization of higher order thinking abilities like investigation, assessment and assures learner that their voices, thoughts, and encounters are esteemed since learners are bound to share thoughts between a non-threatening group of friends.

David, (2015) emphasized that teaching with Gallery Walks Strategy is beneficial since it promote critical reasoning, correspondence and practice with basic assessment of new data as learners contend with difficult concepts. Research study according to John, (2013) revealed that gallery walk is an important strategy for it empowers students to improve their work using criticism from numerous sources like friends, educator and master.

2.3.2 The Gallery Walks Strategy and Students' Attitude

Ridwan, (2015) investigated Gallery Walks as an alternative learning strategy in increasing student active learning. 29 students participated in the research study. After the analysis of the data collected from the field, the result shows that the Gallery Walks exercise effectively engaged student ts' in the learning process .The students were able to obtaine knowledge effortlessly and utilized their skills of understanding; also they were able to create constructive attitude towards the subject and other students. Recommendations were made to this effect that the use of Gallery Walks Strategy in teaching Biology in Senior Secondary Schools should be encourage in order to promote students positive attitude toward the subject in the science class. In conclusion, Gallery Walks Strategy increases the student positive attitude toward the subject. It therefore recommends the teachers to use it for teaching and learning.

2.3.3 The Gallery Walks Strategy and Students' Science Process Skills Acquisition

Suaily, Utaya and Sooetjipto, (2016) investigated how the active strategy enhances the achievement of science process skills by the students. The research work made use of a desidn called Class Action Research (CAR) which is made of two cycles. Each cycle comprises of four methodologies. The information on science process abilities (skills) is accumulated through perception. The information was dissected by utilizing

descriptive analysis. The discoveries of the study demonstrate that there was theme improvement of science process skills acquisition and the intellectual skills of the students. In the first cycle, the learners' science process skills arrived at 71.29% and its increment in cycle II arrived at 81.2%. Recommendation was given that active strategy should be constantly used in the class to promote acquisition of science process skills.

Karamustafaoglu, (2011) explored the degree of science and Innovation pre-service Educators' science process skills acquisition and to decide how productive I graph are in the development of skills. The population comprises of 40 science and Innovation learner educators' who were having instructional Innovation and material Plan course at Amasya university faculty of education. The study was directed as fundamental exploratory plan. A science skill test was applied on the pre-service educators as pre-test and post-test. The outcomes showed that the pre-service teacher had issues with the pretest and particularly with the coordinated process skills. At the tail end of the research work it was seen that the pre-service teachers' skills were expanded just as their incorporated process skills issues were vanished. It was inferred that students need to obtain skills i.e science processskills with the goal of solving problems in science class.

2.3.4 The Mind Mapping Strategy and Students' Achievement

A Mind Mapping is a diagram used to represent words, thoughts, idea, topics or different things connected to central key point or thought (Ogundele, 2015). Mind maps are viewed as a sort of bug picture (Cambridge Dictionary Online, 2015). Ogundiwin, (2013) expressed that without sufficient method, a clearly stated objective and deliberately organized content students are prone to fail since methodologies are ways by which the students are kept motivated in the showing exercises which bring about the learning. The purpose of reviewed the related literatures is to determine what gap this present study will fill and its contribution to the body of knowledge.

Ogundele, (2015) examined the adequacy of Mind Mapping and Concept Mapping as learning devices on students learning outcomes in science. The investigation used pretest-post test design plan with a benchmark (control) group was utilized. The sample contained 300 SS1 science students. The outcome shows that Mind Mapping achieved the main change in the learning outcomes of students. When compare it standard deviation with other strategies i.e. Mind Mapping (SD=2.970), Concept

Mapping (SD=2.318) and lecture method (SD=2.165). It revealed that Mind Mapping is an effective strategy for facilitating student achievement in biology.

Gemma, (2009) explored the utilization of Mind Mapping in teaching and learning. After the analysis a survey was utilized to measure the group sentiments (opinion) (22 students were included). Few members of interview panels were selected and interview was conducted. The outcome of the students showed that of 33% of the students delighted in utilizing Mind Mapping in class. Over 80% of students concurred that mind mapping may assist them with recalling data and 72% of learners agreed that brain planning helped them with acknowledging how every point discovers a path into a subject. More than 68% said they would use Mind planning for change and more than 75% of respondents said they should use Mind planning in various subjects. During the gathering, a couple of learners said that they had used Mind Planning in various classes since they had been instructed about them. Only 2 learners responded that they could have done without Mind-Planning. It is similarly proposed that psyche planning may be more fitting for understudies to use for setting everything straight their own contemplations during modification and individual study.

In their study Jibriu, Abdullahi Zayum and Abdullahi, (2012) researched the impacts of mind mapping instructional strategy on the academic accomplishment of senior secondary school science students in environmental concepts. Two senior secondary schools were arbitrarily chosen in Dengi city and appointed into treatment class and control group. The outcome showed that the students that were taught ecology using Mind Mapping performed better than those taught using the normal conventional method. In view of the outcome it was prescribed that educator ought to be urged to utilize Mind Mapping instructional strategy in teaching science.

Adodo, (2013) explored the impacts of Mind Planning procedure (technique) as an independent learning framework on learners in Basic Science and Technology. 100 and twenty (120) learners were chosen using basic simple examining procedures. The outcome showed that Mind-Mapping system as a self-managed learning (SRL) technique assisted with improving learners' achievement and ought to be utilized in the classroom as a superior way to teach for it improved students "critical reasoning" and imaginative abilities. Furthermore, it should be implore in the teaching of other science subjects.

2.3.5 The Mind-Mapping Strategy and Students' Attitude.

Martin, (2015) examined the Impact of Utilizing Mind Mapping and Experimental Methods in training Science students the discoveries of the investigation uncovered that learners showed inspirational disposition towards the utilization of Mind Mapping over the utilization of experimental techniques. Suggestions were made that Biology Instructors ought to be urged to utilize Mind Mapping methodologys.

Tungprapa, (2015) examined the impacts of utilizing the electronic Mind Mapping. Study sample incorporates one class of master degree class. The outcome showed that students' post-study attitude towards the examination subject are higher than their pre-study attitude at 0.05 degree of significant. Furthermore the students thought about that use of Mind Mapping ought to be brought into research learning session to improve student's inspirational attitude toward research study.

2.3.6 Mind Mapping and Students' Science Process Skills Acquisition

Suryan, Harahap and Sinulinga, (2017) found out in their research work that science process skills of students tutored with scientific inquiry model utilizing Mind Mapping was superior to students instructed by chalk and talk method, physic science process skill of students who have basic reasoning capacity utilizing mind mapping are better than students who can think fundamentally utilizing chalk and talk methods. Suggestions were made with this impact that Science Educators ought to be urged to utilize mind mapping procedure in training Science in Senior Secondary Schools to advance learners gaining of science process skills in science class.

Salah and Mohammad, (2014) explored the impacts of utilizing mind mapping procedure in enhancement of science process skills. After execution, the investigation found the effect of utilizating Mind Mapping on improve science process skills of female students of the experimental group. This is corroborated by Adams, (2016). Suggestions were made with this impact that Science Instructors ought to be urged to utilize Mind Mapping system in encouraging Science in Senior Secondary Schools to advance students securing of science process skills in science class.

2.3.7 The Learning Style and Students' Achievement

There have been numerous endeavors made to improve learner's scholarly accomplishments. It has consistently been the fundamental worry of many devoted educators and guardians that their learners and children be however much fruitful as could reasonably be expected. Corresponding to this, numerous instructors are persuaded that students need positive attitude to succeed. Regularly, one's learning

style is recognized to decide qualities for scholastic accomplishment. Most students favor to learn specifically in a way with each way making them to retain whatever they learn for a longer time. These realities uncover that each learning style has its own qualities and shortcomings. A few students learn from various perspectives, while others may just favour one or two. Research has revealed that learning styles have significant influence on student's achievement in Biology (Okoye, 2014).

Godwin and Bassey, (2013) examined the impacts of learning styles on students accomplishment in Science. 240 SSII Science students where randomly drawn from six (6) secondary Schools in Uyo city. From the discoveries, a huge impact was found to exist in the learning outcomes of Biologystudent taught with guided-learning styles. The result showed that teachers should have prior knowledge of the learning style of their students before picking their teaching approach. This is supported by the work of Ibe, (2015), Norasyikin, Mimi, and Aini, (2015) Rajshri, (2013) who observed that a suitable learning style could assist students with accomplishing great success in any subject they learned.

2.3.8 The Learning Style and Students'Attitude

Wang, Jang, Yang and Weng, (2015) worked on the impact of media materials of Taekwondo Aerobic on student Learning attitude with diverse learning style. Taekwondo Aerobic class is another subject for junior School students in Taiwan. They utilize progressed digital innovation; media based training style was made use off and applied. Some of the learners were unable to use the materials very well and their learning styles also impact their learning achievement. They were two group, 101questionnaire were utilized. The outcomes show that embracing multimedia based training style advances understudies' learning mentality. Utilizing interactive media based training style affects students learning attitude with various learning styles in instructing Taekwondo Aerobic.

Esen, Ibrahim and Omar, (2003) examined the impact of learning styles on Secondary School students learning outcome in chemistry as a school subject.109 ninth grade and 151 10th grade students taking Chemistry courses from various secondary schools wereselected for the research work. The learning style inventory was utilized to decide students learning styles. Learning stylescale and attitude toward chemistry scale were created and utilized. The data acquired was analysed statistically. Results showed that there was an impact of learning styles on students' perspectives toward chemistry achievement. Students in learning styles group 3 and 4 showed better

comprehension of chemistry topics and more positive attitude toward chemistry as a school subject. Hence student learning style has impact of the student mentalities toward the subject.

2.3.9 The Learning Style and Students' Science Process Skills Acquisition

Meltem, Hakan, Gulcan and Oguz, (2011) explored the connection between the the pre-service science teachers' scientific process skills and their learning styles. Science process skill Test" was created for surveying pre-service educators. When science process skill scores were analyzed, it was seen that the pre-service instructors having several learning styles have higher science process skills scores in contrast with the pre-service educators having one learning styles. A nonequivalent control group quasi experimental design was utilized. A deliberate sample was chosen based on their capacity to convey the treatment to the students register in Agric - Science course. Utilizing regression analysis it was discovered that learning style, instruction technique, ethnicity, content information pre-test scores and science process skills pretest scores represented 335 of variance in content knowledge acquire scores. Learning style, gender, instruction technique, science process skills pre-test scores and content knowledge pretest scores represented 35% of the variance in science process skills acquire score. Students taught utilizing the topic approach or the analytical lab approach were accounted for as having higher science process skills and acquire high scores than students instructed utilizing prescriptive laboratory method.

2.3.10 The Mental Ability and Students'Achievement

Nnorom, (2013) examined the impacts of reasoning abilities on students' achievement, the outcomes of the research revealed that students with high thinking abilities perform better in Biology achievement test over the students who have low abilities. Suggestion was made that the classroom educator should monitor the utilization of various thinking abilities among the students, and students ought to likewise figure out how to utilize their thinking abilities to improve their realizing their academic goal.

Adeyemi and Awolere, (2016) examined the impacts of experiental learning strategy (ELS) and generative learning strategy (GLS) on students' academic achievement in environmental concepts in Biology. The result of their study showed that students with high mental capacity perform better than students with low mental ability and that both strategies improve students learning outcomes.

2.3.11: The Mental Ability and Students' Attitude

Bolaji, Ayanwoye, Adesina, Oyeniran and Wahab, (2015) investigated Mental Ability, Academic Self-Concept and Scientific Attitude as Predictors of Pre-Service Teachers' Achievement in Basic General Mathematics in Oyo State, Nigeria. Literature has identified attitude to Mathematics as a strong factor to students' performance in schools. Four hypotheses guided the study. An ex-post facto design was adopted for the research using two thousand 200 Level pre-service teachers selected through random sampling technique.

Threeresearch instruments were developed and validated, namely: Students Mental Ability Test (SMAT, r = 0.83), Students Academic Self-concept Scale (SASCS, r =0.79), Students Scientific Attitude Questionnaire (SSAQ, r = 0.81). MRA, t-test, Analysis of Variance were used to test the set hypotheses at 0.05 level of significance. The results indicated a significant composite contribution of the predictor variables on the dependent measure ($F(3, 1996) = 19.994$; $R = 0.885$; $R2 = 0.783$; $p < 0.05$). The independent variables significantly predicted the students' attitude to Basic Mathematics with mental ability having higher predictive value ($\beta = .517$; $t = 12.266$; $p < 0.05$) followed by scientific attitude ($\beta = .381$; $t = 6.940$; $p < 0.05$) while students academic self- concept contribution had the least ($\beta = .132$; $t = 2.821$; $p < 0.05$). It was therefore recommended among others that mathematics lecturers should use eclectic teaching strategies that would increase student's mental ability and develop their positive attitude toward science.

2.3.12 The Mental Ability and Students' Science Process Skills Acquisition

Oloyede, (2012) investigated the relationship between acquisition of science process skills and achievement in science. The samples consist of 320 Senior Secondary II students from selected schools in Bauchi state, Nigeria. The instruments used were test of logical thinking, test on science process skills which were administered to the students as well as students third term results from SS I examination in Chemistry. The students' scores on three attributes were correlated using the product moment correlation coefficient. The findings showed a positive relationship between format reasoning ability and acquisition of scienceprocess skills formal reasoning and chemistry achievement and acquisition of science process skills and chemistry achievement. The

implication; some suggestions were made for improvement of science teaching in our secondary school.

Irwanto, Robaeti, Widyajanti and Suyanta, (2017) investigated the Science Process Skills and Analytical Thinking Ability of Senior High School Students in Chemistry. The research was conducted in Tiya market,Yogyakarta Senior High School Indonesia. The survey involved 21 grade XI students as participants students were given a set of test questions consist of 15 essay questions. The result indicated that the science process skill and analytical thinking ability were relatively low i.e 30.67%. Therefore, teachers need to improve the students' cognitive and psychomotor domains effectively in learning process.

2.4 Appraisal of Literature Reviewed

The chapter has examined the literature of previous studies, suggestions and recommendations that were relevant to the present study were made. The theoretical and conceptual framework gave insight into the state of Biology education in Nigeria. That is the teaching and learning of Biology in Nigeria secondary schools. It also gave insight into the concept of learning style and mental ability. The empirical review identified some work done in the areas of instructional strategies, mental abilityand learning style.

On the state of Biology education in Nigeria, the literature revealed that despite all recognition accorded Biology at all levels of educational system; student's achievement has remained unimpressive. This poor achievement, the literature confirmed could be summarily attributed to teacher quality and its indicators, quality of teaching and teaching learning resources among other things. The review incompetence and use of inappropriate teaching strategies as one of the major contributory factors. However, the use of active instructional strategies such as Gallery Walks and Mind Mapping instructional strategies have been revealed to have proved efficacious in other sciences, hence the present reseach study focuses on exploring the effects of Gallery Walks and Mind Mapping instructional strategies on senior secondary school students achievement in genetic concepts in Biology. In line with the above desire, literature was reviewed on concepts of Gallery Walks, Mind Mapping, Learning style, Mental ability and Achievement. Also

reviewed were Vygotsky constructivists of social development and Jean Piaget's constructivist theory of development. It was revealed that it is evident Learning style and mental ability has strong tie with Achievement, it was also revealed that inappropriate instructional strategies leads to lack of understanding of concepts and this invariably lead to poor Achievement. The poor achievement in Biology has been attributed to inappropriate instructional strategies that teachers employed in the classroom which invariably lead to increase of development of negative attitude of students towards the subject.

The previous study largely focus on the student factors, school factors and home factors, this is in line with the finding of Hanes, (2008) who reported that students factors, family factors, school factors and peer factors have influence on students achievement in secondary schools William, (2016) complement the findings when he asserted that family in our society need to give adequate attention to the education of their children. More also, Chukwudi, (2013) investigated the effects of home environment on academic achievement of secondary schools students in Nigeria; results indicated that parent with high educational background tend to motivate their children to have an interest in their academicwork; this also enhance performance of students in secondary schools. Only little emphasis has been laid on the effectiveness of Gallery Walks and Mind Mapping Strategies in enhancing students learning outcomes on the genetic concepts in Biology.

To facilitate the acquisition of problem-solving skills in Biology, active instructional strategy such as Gallery Walks and Mind Mapping instructional strategies were explored. This is the focus of this study. It was asserted that since the search for variety of instructional strategies that could facilitate acquisition of problem-solving skills and enhance achievement continues, it is evident that the Biology educators are concerned with positive change in the method of instruction.It is based on this; therefore, this research study wasdesigned to obtain the effects of Gallery Walks and Mind Mapping Strategies on students' Learning Outcomes in genetic concepts in Biology. The moderating effects of Learning Style and Mental Ability were also determined. The research study aimed at complementing the earlier efforts of reseachers, and to fill in the gaps.This necessitated this study.

CHAPTER THREE

METHODOLOGY

This chapter deals with research design, population, sampling procedure and sample, instruments for data collection, validity of instruments and reliability of instrument, methods of data collections and strategy of data analysis.

3.1 Research Design

This study adopted the pretest-posttest control group quasi-experimental research design with a 3x3x3 factorial matrix. It was used to examine and find out the effectiveness of the instructional strategies (Gallery Walks and Mind Mapping Strategies) on SS two students' achievement, attitude and science process skills acquisition in genetic concepts in Biology. The symbolic representation of the research design is shown below;

O_1 X_1 O_2 (E_1)

O_3 X_2 O_4 (E_2)

O_5 C O_6 (C)

Where

O_1 O_3 O_5 represents pre-test

O_2 O_4 O_6 represents post- test

E_1 and E_2 represents experimental group 1and 2

C represents control group

O_1 – Represents pre-test for the experimental group i.e. Gallery Walks Strategy of teaching

O_2– Represents post-test for the experimental group 1 i.e. Mind Mapping Strategy of teaching

O_3 – Represents pre-test for experimental group 2 i.e. Gallery Walks Strategy of teaching

O_4– Represents post-test scores for experimental group 2 i.e. Mind Mapping Strategy of teaching

O_5 – Represents pre-test for control group i.e. Conventional Strategy of teaching

O_6 – Represents the post-test scores for control group i.e Conventional Strategy of teaching

X_1 – Represents the treatment for experimental group $E._1$ (Gallery Walks Strategy of teaching)

X_2 – Represents treatment for experimental group E_2 (.Mind Mapping Strategy of teaching)

C– Represents the trtmt for control group C (Conventional Strategy of teaching)

The outline of the factorialmatrix design is shown in the Tab. 3.1

Tab. 3.1: 3x3x 3 Factorial Matrixes

Trtmt / Strategies	**Learning Style**	**Mental Ability**		
		High	**Medium**	**Low**
GalleryWalks Strategy	Visual			
	Auditory			
	Kinesthetic			
MindMapping Strategy	Visual			
	Auditory			
	Kinesthetic			
Conventional Strategy	Visual			
	Auditory			
	Kinesthetic			

3.2 Variables ofthe Research Study

The followingwere the Variablesof the study,

(a) Independent Variable

(b) Moderating Variables

(c) DependentVariables

(a) **Independent Variable:** Is the instructional teaching strategy, which forms the trtmt that varies at three (3) levels.

(i) Gallery Walks Strategy

(ii) Mind Mapping Strategy

(iii) Conventional Strategy

(b) **Moderating Variables:** The moderator variables are

(i) Learning Style at three levels: Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style (VAK),

(ii) Mental Ability at three levels: High Mental Ability, Medium Mental Ability and Low Mental Ability

(c) **Dependent Variables.**

(i) Achievement in Genetic Concepts in Biology

(ii) Attitude to Biology

(iii) Science Process Skills in Genetic Concepts in Biology.

3.3a Selection of Participants

The participants were chosen from three Senatorial Districts of Kwara State (Kwara North, Kwara Central and Kwara south). Three (3) Local Governments Area were randomly selected from one senatorial district (Kwara South). The three Local Governments were, Irepodun, Oke-Ero and Ekiti with 25, 10 and 13 public schools respectively. Three (3) schools were randomly selected from each local government area making a total of nine (9) schools and intact classes were used. The participants for the study consisted of 365. The teachers of selected classes (3) teachers per each local government were also used for the study. The nine schools were distantly located from each other to avoid interaction taking place between or among students from the selected schools of the study. The treatment was randomly assigned to the three schools, one strategy for school. Gallery Walks Strategy, one school for Mind Mapping

Strategy, and one school for Conventional Strategy in each Local Government Area of the study.

The criteria used in selecting the schools were based on multi-stage stratified sampling procedure with the following criteria:

(i) Schools with experienced biology teachers

(ii) The school must have produced candidates for public examination such as WAEC and NECO for not less than 5 years.

(iii) Willingness of the required members of staff to participate.

The nine schools were randomly assigned to treatment and the control groups. An intact class of the representative schools was used for the research.

3.3b Selection of Topics /Concepts

Genetic concepts in biology were selected for the purpose of this study.Genetics: Transmission and Expression of characters from parent to offspring; First Mendelian law; Second Mendelian law; Chromosomes the basis of heredity; Probability in genetics; Application of the principle of heredity in agricultural science and medicine.

3.4 Research Instruments

Nine instruments were usedin the research study. They include;

1. Genetic Concepts in Biology Achievement Test (GCBAT)
2. Students Attitude Toward Biology Scale (SATBS)
3. (a) Biology Students Science Process Skills Acquisition Scale (BSSPSAS)
   (b) Biology Students Science Process Skills Acquisition Rating Scale (BSSPSARS)
4. Biology Students Learning Style Test (BSLST)
5. Biology Students Mental Ability Test (BSMAT)
6. Teachers Guide on Gallery Walks Strategy (TGGS)
7. Teachers Guide on Mind Mapping Strategy (TGMS)
8. Teachers Guide on Conventional Strategy (TGCS)
9. Evaluation Sheet for Assessing Teachers'PerformanceDuring Training. (ESATPDT)
   a.Gallery Walks Strategy (ESATGS)
   b, Mind Mapping Strategy (ESATMS)
   c, Conventional Strategy (ESATCS)

3.4.1 Genetic Concepts in Biology Achievement Test (GCBAT)

Genetic Concepts in Biology Achievement Test (GCBAT) was designed by the researcher and it is purposefully designed to measure the achievement of Biology learners in genetic concepts. The achievement test is made up oftwo sections, A and B. Section A is the demographic session while the section B is made up of the test questions.

Tab. 3.2: The Specification Table for Biology Students Achievement Test (BSAT).

S/N	Content	Remembering Information	Understanding	Thinking	Total
1	Meaningof Genetics	1, 9, 24	32	11	5
2	Transmission and Expression of Characters	6, 19	5, 7	12, 18	6
3	First Mendelian Law	28, 30	21, 22, 23	23	6
4	Second Mendelian Law	14	16	13	3
5	Chromosomes /DNA Basis of life	3, 17	4, 29	10, 2	6
6	Probability in Genetics	15	26	8	3
7	Application of the principle of Genetics in Agricultural Science and Medicine	27	26	8	3
	Total	12	12	8	32

3.4.1.1 Validation of GCBAT

Originally, 60 questions were set on genetic concepts. The questionswere given to four teachers teaching biology in secondary school and one experience evaluator to establishd the validity of the questions. This was carried out in order to ascertain whether the instrument is fit for the students. After their scrutiny, 50 questions were left. These 50 questions were the one who falls within the discriminating power of 4-7 as those that fall below 4 were considered too simple and those that falls above 7 were considered to be difficult for the students.

3.4.1.2 Reliability of GCBAT

The questions were trial-tested in a secondary school that was not nominated for the research study. Kr 20 was used in analyzing the data and of 0.86 was obtained as reliabity coefficient.

3.4.2 Students Attitude to Biology Scale (SATBS)

The instrument was purposefully designed to investigate the student's attitude toward Biology and was developed by the researcher. It is partitioned into two sections. Section A is made up of students' bio-data, Section B has items measuring students' attitude to biology. It comprises of 20 items on a 4-point liker type scale ranging from:

Strongly agree	-	4marks
Agree	-	3 marks
Strongly disagree	-	2 marks
Disagree	-	1 marks

3.4.2.1. Validation and Reliability of (SATBS)

The qustionnaire was given to lecturers to ascertain its content validity. The test instrument was also examined by researchers' supervisor in orderto ensure whetherthe items measure theintended content. Their suggestions were used in the final draft. The Cronbach alpha formular procedure was applied by the researcher to find the reliability co-efficients. In order to do this, some learners which were outof the student area in the same local government areas were used to ascertain the reliability co-efficientof the instrmt. The reliability Cronbach Alpha co-efficientof 0.89 was obtained and itwas considered high enough for the instrument to be used for the work.

3.4.3a. BiologyStudents Science Process Skills Acquisition Scale (BSSPSAS)

The questionnaire was developed by the researcher to measure students acquired science process skills. It is made of two sections. The first parts covers the demographic factors, while the second part is made up of items on the science process skills, it is made up of six questions that cut across the following science process skills; Observing, inferring, graphing, recording, predicting and experimenting. The scoring criteria of the pretest and post- test was according to the rating scale that is designed by the researcher. The rating scales used was BSSPSARS; The rating scales varies according to the question. Question no 1 is from 0 -1, question no 2 is from 0-2, question no 3 is from 0-2, question no 4 is from 0-3 , question no 5 is from 0-10 and question no 6 is from 0-10.

3.4.3a. Validation and Reliability (BSSPSAS)

Initially, 11 test questions were set on science process skills Acquisition. The test questions were given to teachers teaching biology in secondary schoolsand an evaluator. This was carried out to make sure that the questions are valid. Amendments were made and only six (6) test items survived. Thereafter, the reliabity test was determined by admistering the questionnaire on schools who are not meant for the research Product Correlation Coefficient Analysis of 0.83 was obtained and difficulty index of 0.48 were observed.

Table 3.3: Table that shown the Average Reliability Co-efficient for (BSSPSS)

S/N	Science Process skills	No of question	Total number of question	Reliability co-efficient PO	K	Cut-off score
1	Recording	5	1	0.90	0.82	40%
2	Observing	2	1	0.89	0.77	40%
3	Inferring	3	1	0.89	0.77	40%
4	Graphing	6	1	0.88	0.74	40%
5	Predicting	1	1	0.89	0.77	40%
6	Experimenting	4	1	0.87	0.74	40%

3.4.3b. Biology Students Science Process Skills Acquisition Rating Scale (BSSPSARS)

The Rating Scale (BSSPSARS**)** Instrument was adapted from Adegoke (2015) by the researcher for this study and it served as a marking guide. This instrument is made up of six items and these were distributed among the six science process skills which were, recording, observing, inferring, graphing, predicting and experimenting. The rating scale varies according to the question. Question no 1 is from 0 -1, question no 2 is from 0-2 , question no 3 is from 0-2 , question no 4 is from 0-3 , question no 5 is from 0-10 and question no 6 is from 0-10.

3.4.3b. Validation of BSSPSARS

The instrument was given to experts for view, their opinion and advice were used to either discard or rework the items. The instrument was used by three independent rater's to observe and ratethe students after using the Biology Student Science Process Skills Acquisition Scale.

3.4.4 Biology Students Learning Style Scale (BSLSS)

The learning style test developed by Jonelle A. Beatrice in 1995 and digitized in 2009 was adopted for this study. It is suitable for this study since it has been standardized for use in categorizing learners into their learning modality. The instrument is made up to two sections A and B. Part A consists of personal data of students such as school names, student's name, age and sex. Section B consists of fourteen questions to which correct choice that best describes each learner are to be supplied by ticking the letter A, B and C. It is designed to group students into Kinesthetic (A), Visual (B) and Auditory (C). In grouping the students into the different categories of learning styles, the area students tick highest numbers of responses will be their mode of learning

3.4.4.1 Validation of Biology Students Learning Style Scale (BSLSS)

This was carried out by subjecting it to the scrutiny of test and measurement. The test items were administered to SS two students in the concerned schools using split half method of odd and even numbers of the items. For the present study the Learning Style Scale was trial tested twice (separated by two weeks) using 25 SS II students of the field-testing school, (Emmanuel College, Ibadan.) in order to further ensure its validity and reliability. A test-retest reliability value of 0.81 was obtained.

3.4.5 Biology Students Mental Ability Test (BSMAT)

The Australian Council for Education Research (ACER) Higher test quoted by Igwe (2002) was adopted for this study in order to use it for measuring of student's level of cognitive ability (high, medium and low). It is considered appropriate for this study because it has been standardized for use in categorizing learners into ability levels. The instrument is divided into two sections A & B. Section A consists identity such as school name, students name etc. Section Bconsists of twenty multiple choice questions to which correct answer are to be supplied. It was designed to group students into either high ability level, medium ability level or low ability level. Students who scored below the average mark (0-7) will be grouped as low achievers; those who scored between average mark (8-14) will be grouped as medium achievers while those who scored above the average mark (15-21) was grouped as high achievers.

3.4.5.1 Validation and Reliability of BSMAT

This was carried out by subjecting it to the scrutiny of test and measurement. The test items was administered to SS two students in the concerned schools using split half method of odd and even numbers of the items. The reliability coefficient was calculated and using Kuder Richardson Kr 20(r=0.87) was obtained as reliability

3.4.6 Teachers' Instructional Guides (TIG)

These instruments described how instructions were carried out for the different groups, and they contain the following; topic(s), subjects, content, class, and reference book, teaching aids, objectives, presentations, summary and evaluation. The drafts of Teachers Instructional Guides were examined by four experienced biology teachers for suitability for classroom use.

3.4.6.1 Teacher's Guide on Gallery Walks Strategy (TGGS)

The instrument is in form of lesson notes based on the genetic concepts in Biology.

Step 1:The teacher creates and post questions;

(i) The teacher creates questions based on the objective of the concept to betaught.

(ii) The number of questions created is the same with the number of the Gallery Walks classroom station

(iii) The teacher distribute the questions to the various Gallery Walks classroomStation; a question per station.

Step 2:Thestudents' were grouped and collect their assigned roles.

(i) The students assigned roles such as; Recorder, Reporter, Time keeper and Leader.

Step 3: The group moves to their first assigned stations.

(i) The group begin comment on the concepts of the day

Step 4: The group rotates to the next station clockwise

(i)The rotation will take place after spending five to eight minutes in astation.

(ii) The group adds new comment to the gallery work sheet (note) left by the previous group.

(iii) The teacher acts as a facilitator he/she moves round the Gallery Walks Classroom in order to monitor the way by which the students carried out their group activities,

Step 5:The students begin oral presentation.

(i) Each group will be giving five to ten minutes to present oral report

(ii) Facilitator will reinforce good presentation and corrects misconception of idea or concepts.

3.4.6.1.1 Validation of Teachers Guide on Gallery Walks Strategy (TGGS)

The draft of the Teacher's Guide on Gallery Walks Strategy were given to five experienced Biology tutors in selected secondary schools. This wasdone in order to ensure the face, contentand construct validityof the guide. These teachers are seasoned WAEC, NECO and NABTEB examiners, and based on their comment and suggestion necessary amendments were made.

3.4.6.2 Teacher's Guide on Mind Mapping Strategy (TGMS)

The instrument is in form of lesson notes based on the genetic concepts in Biologyusing the Mind Mapping Strategy

Step 1: The teacher instructs the student how to create a central idea

(i) Central idea will be at center of students mapping sheet page

(ii) Insert image that will represents Mind Mapping's topic.

Step 1: The students add branches to their map.

(i) Let the main branch that come from central idea thicker.

(ii) Many branches of sub idea can be added to the main branch

Step 3: The student adds key words to the map

(i)Adds important key word to a branch: one word per branch

Step 4: **The students color (code) the branches of the map**

(i)Create a mental shortcut to your map by colour code it with differentcolour

Step 5: The students include images to their map

(i) Insert relevant images to your map to make it an imagery map.

3.4.6.2 .1 Validation of Teacher Guide on Mind Mapping Strategy (TGMS)

The draft of the teachers guide on Mind Mapping Strategy were given to five experienced Biology tutors in selected Secondary Schools. This was done in order to ascertain the suitabilityof the instrument. These teachers were seasoned WAEC, NECO and NABTEB examiners. Based on their comments and suggestions necessary amendment were made.

3.4.6.3 Teacher's Guides on Conventional Strategy (TGCS)

The instrument consisted of lesson guides on the genetics topic using the following procedural steps.

Step1: The educator presents the lesson by posing questionson what they have been taught in the past.

Step2: Teacher presents the teaching aids and explanation of the contents ofthe lesson.

Step3 : Teacher asks thelearners to copy the note written on the chalkboard intheir note book.

Step4: Teacher asks some questions to evaluate the students

Step 5: Teacher gives assignments/home work.

3.4.6.1 Validation of Teachers Guides on Conventional Strategy (TGCS)

The draft of the teacher's guide on conventional strategy were given to five experienced biology teachers in selected secondary schools. This was carried out to determine the suitability of the guide (instrument). These teachers are seasoned WAEC, NECO and NABTEB examiners and based on their comment and suggestion, necessary amendments were made.

3.4.7 Evaluation Sheetfor Assessing Teachers Performance on theuse of the strategies (ESATP)

During the training of the participatory teachers for two weeks, the researcher requested the tutors to give demonstration lesson which was assessed by the researcher using the ESATP, to ensure strict compliance to the guide. The ESATP is attached in appendix VI, VII and VIII.

Gallery Walks Strategy - Appendix V1

Mind Mapping Strategy - Appendix V11

Conventional Strategy - Appendix V111

3.4.7.1 Validation of Evaluation Sheet

The draft of the ESATP during training was given to five experienced Biology teachers in selected secondary schools. This was carried out to see that the content was suitable and the instrument was a valid one. These teachers are seasoned WAEC, NECO and NABTEB examiners. Based on their comments and suggestions necessary amendment were made.

3.5 Research Procedure

The instruments were first administered on the students to pre-test them and their marks were recorded. The students were grouped into experimental group I and 2 and genetics concepts in Biologywere taught using Classroom Gallery walks and Mind Mapping Strategies and these spans through the period of eight weeks. Conventional method of teaching was used for the control group and it also lasted for eight weeks.

3.5.1 Work Schedules

The research study schedule of work wasfollows:

1)	Visitation to the schools	- 1 week
2)	Training of teachers (research assistants) and scrutiny	- 3 weeks
3)	Pre-test (all instruments)	- 1 week
4)	Treatment	- 8 weeks
5)	Post –test	-1 week
	Total	**- 14 weeks**

3.5.2 Training of Research Assistants

Research assistant were trained using

a) Teachers guide on Gallery Walks

b) Teachers guide on Mind Mapping strategy

c) Teachers guide on Conventional Strategy

The training materials will be given to them, the teaching guide for all groups has for its content the following areas of genetics topics in Biology; Genetics; Transmission and Expression of characters from parent to offspring; First Mendelian law; Second Mendelian law; Chromosomes thebasis of heredity; Probability in genetics; Application of the principleof heredity in agricultural science and medicine. Also, the research assistants will be trained on how to administer the instruments.

3.5.3 Pretest

The pre-test material was given to them after they have been trained. Their first contact with the students' in the classroom is for introduction / familiarization and inform the students the purpose, principles and procedures governing the research. The students will be informed the benefits they stand to gain if they participated fully from the beginning of the programme to the end. The attitude (Students Attitude Toward Biology SATB) questionnaire will be administered first followed by Biology Students Learning Style (BSLS), Biology Students Mental Ability Test (BSMAT), Biology Students AchievementTest (BSAT) and Biology Students ScienceProcess Skills Acquisition Scale (BSSPSAS)

3.5.4 Treatment

The Experimental Groups (Gallery Walks and Mind Mapping): The students were introduced to the genetics concepts in Biology and allowed to ask probing and pertinent questions that caused then to discover and understand genetics concepts better.

3.5.4.1 Experimental group I (Gallery Walks Strategy) steps include

Teacher's Guide on Gallery Walks Strategy (TGGS)

The instrument was in form of lesson notes based on the genetic concepts in Biology.

Step 1:The teacher creates and post questions;

(i) The teacher creates questions based on the objective of the concept to be taught.

(ii) The number of questions created is the same with the number of the Gallery Walks Classroom station

(iii) The teacher distribute the questions to the various Gallery Walks Classroom Station; a question per station.

Step 2: The students' were grouped and collect their assigned roles.

(1) Students were group into (five -eight each) in a group.

(i) The students collect their assigned roles such as; Recorder, Reporter, Time keeper and Leader.

Step 3: The group moves to their first assigned stations.

(i) The group begin comment on the concepts of the day

(ii) The group members write their name on the Gallery Walks attendance sheet

Step 4: The group rotates to the next station clockwise

(i) The rotation will take place after spending five to eight minutes in a station.

(ii) The group solves the station task on the Gallery Walks question and answer sheet.

(iii) The teacher acts as a facilitator he/she moves round the Gallery Walks Classroom in order to monitor the way by which the students carried out their group activities.

(iv) The students submit their answer sheet before they move to the next station

Step 5: The students begin oral presentation.

(i) Each group will be giving five to ten minutes to present oral report

(ii) Facilitator will reinforce good presentation and corrects misconception of idea or concepts.

3.5.4.2 1 Experimental group II (Mind Mapping) steps include

Teacher's Guide on Mind Mapping Strategy (MMS)

The instrument is in form of lesson notes based on the genetic concepts in Biology using the Mind Mapping Strategy

Step 1: The teacher instructs the student how to create a central idea

(i) Central idea will be at the centre of students mapping sheet page

(ii) Insert image that will represents Mind Map's topic.

(iii)Place images (topics) at the centre of the map

(iv)Use irregular shape (to foster knowledge retention)

Step 2: The students add branches to their map.

(i) Students connect line starting from central idea

(ii) The central line are thicker.

(iii) The line becoming thinner as they radiate out from center

(iv) Many branches of sub idea can be added to the main branch

Step 3: The student adds key words to the map

(i) Students outline the branch (numerical order)

(ii) Each word is sitting on its own line

(iii) Addition of important key word to a branch:

(iv) One word per branch

Step 4: **The students colour (code) the branches of the map**

(i) Student create a mental shortcut of their map by colour code it with different colours

(ii) Students code their map with upper case letters i.e. A B C D E F etc.

(iii) Students code their map with lower case letters. i.e. a b b c d e f ....etc

Step 5: The students include images to their map

(i) Insert relevant images to their map to make it an imagery map.

(ii) Students add symbol to their map (to make it symbolic).

3.5.4.3 Control group (Conventional Strategy) steps includes

Step i: The educator presents the lesson by posing questions on what they have been taught in the past

Step ii: The teacher shows the teaching aids to the students and discuss the content ofthe lesson.

Stepiii: The teacher direct thelearners to copy the content of the lesson inside their notebooks.

Step iv: The tutor measures the lesson by asking learners some questions.

Stepv: The teacher gives home work to the students.

The training of the research assistant was done for a period of two weeks while the treatment for both the experimental and the control groups were carried out within eight weeks in each of the nine schools.

3.5.5 Post-test

At the end of the treatment, the three groups were exposed to the achievement, attitude to Biology scale and science process skills Acquisition test as post-test. The test/scale items were re-arranged so that subjects could not be easily recognized by the students.

3.6 Method of Data Analysis

The data were analyzed using descriptive statistics (mean, standard deviation) including Bar charts to explain the mean distribution of various groups. Analysis of Covariance (ANCOVA) of inferential statistics was used in testing the hypotheses using the pretest scores as covariates. Multiple Classification Analysis (MCA) was used to determine estimated marginal means of different groups. Bornferroni posthoc test was used where significant main effects were obtained. Lined graph was used to explain the significant interaction effects.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1.1 Testing of Null Hypotheses

4.1.1Ho1a: There is no significant main effect of treatment on students' achievement in Biology.

Table 4.1: Summary of 3x3x3 Analysis of Covariance (ANCOVA) of Post-Achievement by Treatment, Mental ability and Learning style

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2567.620	27	95.097	3.264	0.000	0.209
Intercept	5318.241	1	5318.241	182.536	0.000	0.353
Pre-Test	79.460	1	79.460	2.727	0.100	0.008
Trtmt	1026.495	2	513.248	17.616	0.000*	0.095
Mental ability	53.919	2	26.960	0.925	0.397	0.006
Learning style	19.394	2	9.697	0.333	0.717	0.002
Trtmt x Mental ability	453.304	4	113.326	3.890	0.004*	0.045
Trtmt x Learning style	252.324	4	63.081	2.165	0.073	0.025
Mental ability x Learning style	33.831	4	8.458	0.290	0.884	0.003
Trtmtx Mental ability x Learning style	206.523	8	25.815	0.886	0.528	0.021
Error	9731.200	334	29.135			
Total	113511.000	362				
Corrected Total	12298.820	361				

R Squared = 0.21 (Adjusted R Squared = 0.15) * denotes significant $p<0.05$

Table 4.1 indicates that the main effect of treatment on students' achievement in Biology ($F_{(2, 361)}$ =17.62; $p<0.05$, partial η^2 =0.10) was significant. The effect is 10.0%. This indicates that 10.0% out of the total 15.0% variation (Adjusted R^2 = 0.15) instudents' post-achievement scores in genetic concepts in Biologyin this ANCOVA model was due to the significant main effect of the treatment on students' achievement in genetic concepts in Biology. Hence, hypothesis 1a was rejected.Estimated marginal means of the treatment groups were carried out to determine the effect of the treatment across the group and the result is shown in Tab. 4.2.

Table 4.2: Estimated Marginal Means (EMM) for Post-Achievement by Treatment and Control group

			95% Confidence Interval	
Treatment	Mean	Std. Error	Lower Bound	Upper Bound
Gallery Walks Strategy (GWS)	16.52	0.61	15.31	17.72
Mind Mapping Strategy (MMS)	19.34	0.54	18.28	20.40
Conventional Strategy (CS)	14.76	0.56	13.65	15.87

Table 4.2 shows that students exposed to the Mind Mapping Strategy (MMS) treatment group 2 hadthe highest adjusted post-achievement mean score in genetic concepts in biology ($\bar{x} = 19.34$) than those in the Gallery Walks Strategy (GWS) treatment group1($\bar{x} = 16.52$) while the learners' in theConventional Strategy (CS) control group had the least adjuste mean achievement score ($\bar{x} = 14.76$). This order is represented MMS >GWS > CS. The Bonferroni post-hoc test was carried out across the groups to detect which of the group cause this significant main effect of treatment on students' achievement in genetic concepts in Biology, while the result is presented in Table 4.3.

Table 4.3: Bonferroni Post-hoc Analysis of Post-Achievement by Treatment and Control Group

Treatment	Mean	GWS	MMS	CS
Gallery Walks Strategy (GWS)	16.52		*	
Mind Mapping Strategy (MMS)	19.34	*		*
Conventional Strategy (CS)	14.76		*	

*Pairs of groupsignificantly different atp<0.05

Tab.4.3 indicates that the post-achievement in genetic concepts in Biology mean score of students exposed to the Mind Mapping Strategy (MMS) was significantly different from those in theGallery Walks Strategy (GWS)but not differentfrom those in theConventional Strategy (CS). The difference in the post-achievement mean scores of students exposed to Gallery Walks Strategy and those in the Conventional Strategy was significant. This indicates that the significant difference revealedby the ANCOVA result was due to the difference between the treatment groups (Mind Mapping and Gallery Walks Strategies) but between one of the treatment groups (Gallery Walks Strategy) and the control group as students' post-achievement scores in genetic concepts in Biologyis concerned.

4.1.1Ho1b: There will beno significant main effect of treatment on students' attitude to biology

Table 4.4: Analysis of Covariance (ANCOVA) of Post-Attitude by Treatment, Mental ability and Learning style

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4632.795	27	171.585	1.977	0.003	0.138
Intercept	21348.401	1	21348.401	245.929	0.000	0.424
Pre-Attitude	431.837	1	431.837	4.975	0.026	0.015
Trtmt	1881.088	2	940.544	10.835	0.000*	0.061
Mental ability	195.229	2	97.615	1.124	0.326	0.007
Learning style	52.331	2	26.166	0.301	0.740	0.002
Trtmt x Mental ability	711.855	4	177.964	2.050	0.087	0.024
Trtmt x Learning style	26.236	4	6.559	0.076	0.990	0.001
Mental ability x Learning style	141.738	4	35.435	0.408	0.803	0.005
Trtmt x Mental ability x Learning style	191.697	8	23.962	0.276	0.973	0.007
Error	28993.603	334	86.807			
Total	1074796.000	362				
Corrected Total	33626.398	361				

R Squared = 0.14 (Adjusted R Squared = 0.07) * denotes significant $p<0.05$

Table 4.4 reveals that there was significant main effect of treatment on students' attitude to genetic concepts in Biology ($F_{(2, 361)}$ =10.84; $p<0.05$, partial $\eta^2 = 0.06$). The size effect is 6.0%. This means that 6.0% of the total difference in students' post-attitude to genetic concepts in Biology scores was as the results of the significant maineffect of the treatment. This means that differences between the attitude to genetic concepts in Biology score of students when expose to treatment group was significant. Hence, hypothesis 1b was rejected. Estimated marginal means of the treatment groups were carried out to determine the effect of the treatment across the group and the result ispresented in Tab.4.5.

Table 4.5: Estimated Marginal Means for Post-Attitude by Treatment and Control group

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Gallery Walks Strategy(GWS)	56.68	1.07	54.59	58.78
Mind Mapping Strategy(MMS)	55.18	0.93	53.35	57.00
Conventional Strategy(CS)	50.38	0.97	48.46	52.29

Table 4.5indicates that students in theGallery Walks Strategy (GWS)treatment group 1 ($\bar{x}$ =56.68) hadthe highest adjustedpost-attitude to genetic concepts in Biology mean score,followed by the Mind Mapping Strategy(MMS) treatment group11 ($\bar{x}$ =55.18) while the students in the Conventional Strategy (CS)control group had the least adjusted mean attitude mean($\bar{x}$ =50.38). This order is represented GWS>MMS >CS.The Bonferroni post-hoc test was carried out across the groups to detect which group cause the significant main effect, while the result is presented in Tab. 4.6

Table 4.6: Bonferroni Post-hoc Analysis of Post-Attitude by Treatment and Control Group

Treatment	Mean	GWS	MMS	CS
Gallery Walks Strategy (GWS)	56.68			*
Mind Mapping Strategy (MMS)	55.18			*
Conventional Strategy (CS)	50.38	*	*	

*Pairsof group significantly different at $p<0.05$

Tab.4.6 revealsthat the post-attitude to Biology mean score of students exposed to the Gallery Walks Strategy (GWS)was not significantly differ from those in theMind Mapping Strategy (MMS)but was significantly variant from those in theConventional Strategy (CS). Also, the difference in the post-attitude mean scores of students in theMind MappingStrategy and those in the conventional strategy is significant. This implies that the significant difference showedby the ANCOVA result is not due to the difference between the treatment groups (Mind Mapping and Gallery Walks Strategies) but between the treatment groups (Gallery Walks and Mind Mapping Strategies) and the control group as students' post-attitude scores to Biology is concerned.

4.1.1Ho1c: There will be no significant maineffect of treatment on students' SPS in biology

Table 4.7: Analysis of Covariance (ANCOVA) of Post-Science Process Skills Acquisition by Treatment, Mental ability and Learning style

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	15029.632	27	556.653	4.968	0.000	0.287
Intercept	70477.367	1	70477.367	629.027	0.000	0.653
Pre-Science process skills	244.831	1	244.831	2.185	0.140	0.006
Trtmt	6864.830	2	3432.415	30.635	0.000*	0.155
Mental ability	224.733	2	112.366	1.003	0.368	0.006
Learning style	10.389	2	5.195	0.046	0.955	0.000
Trtmt x Mental ability	1542.240	4	385.560	3.441	0.009*	0.040
Trtmt t x Learning style	327.890	4	81.973	0.732	0.571	0.009
Mental ability x Learning style	27.936	4	6.984	0.062	0.993	0.001
Trtmt x Mental ability x Learning style	2149.999	8	268.750	2.399	0.016*	0.054
Error	37421.973	334	112.042			
Total	1129645.000	362				
Corrected Total	52451.605	361				

R Squared = 0.29 (Adjusted R Squared = 0.23) * denotes significant $p<0.05$

Table 4.7 indicates that the main effect of treatment on students' science process skills acquisition in genetic concepts in Biology ($F_{(2, 361)}$ =30.64; $p<0.05$, partial η^2=0.16) was significant. The effect is 16.0%. This implies that 16.0% out of the total 23.0% variation (Adjusted R^2 = 0.23)in students' post-science process skills Acquisition scores in genetic concepts in Biology in this ANCOVA model was due to the significant main effect of the treatment on students' science process skills acquisition in genetic concepts in Biology. Thus, hypothesis 1c was rejected. This implies that there was significant difference in science process skills acquisition of students exposed to treatment.The estimated marginal means of the treatment groups were carried out to detect the magnitude of the main effect of the treatment and the result is presented in Tab.4.8.

Table 4.8: Estimated Marginal Means for Post-Science Process Skills by Treatment and Control group

			95% ConfidenceInterval	
Treatment	Mean	Std. Error	LowerBound	Upper Bound
Gallery Walks Strategy(GWS)	59.85	1.20	57.49	62.22
Mind Mapping Strategy(MMS)	56.78	1.06	54.69	58.87
Conventional Strategy(CS)	47.70	1.11	45.51	49.89

Tab. 4.8 indicated that students in the Gallery Walks Strategy (GWS)treatment group 1 ($\bar{x} = 59.85$) hadthe highest adjusted post-science process skills acquisition in genetic concepts in Biology mean score, followed by the Mind Mapping Strategy(MMS) treatment group11 ($\bar{x} = 56.78$) while students in the Conventional Strategy (CS) control grouphad theleast adjusted mean in science process skills acquisition (47.70). This order is represented GWS >MMS >CS. Bonferroni post-hoc test was carried out across the groups to know which group causes significant main effect, while the result ispresented in Tab. 4.9.

Table 4.9: Bonferroni Post-hoc Analysis of Post-Science process skills by Treatment and Control Group

Treatment	Mean	GWS	MMS	CS
Gallery Walks Strategy (GWS)	59.85			*
Mind Mapping Strategy (MMS)	56.78			*
Conventional Strategy (CS)	47.70	*	*	

*Pairsof group significantly differentat $p<0.05$

Tab.4.9 revealed that the post-science process skills acquisition in genetic concepts in Biology mean score of students exposed to the Gallery Walks Strategy (GWS)was significantly difference from those in theMind Mapping Strategy (MMS)but is significantly different from those in theConventional Strategy (CS). Also, the difference in the post-science process skills acquisition of students in the Mind Mapping Strategy and those of the Conventional Strategy is significant. This implies that the significant difference showed by the ANCOVA result is not as the results ofthe difference between the treatment groups (Mind Mapping and Wallery Walks Strategies) but between the treatment groups (Gallery Walks and Mind Mapping Strategies) and the control group as students' post-science process skills acquisition in genetic concepts in Biology was concerned.

Main Effect of Mental Ability

4.1.2Ho2a: There will be no significant main effect of mental abilityon students' achievement in genetic concepts inBiology

Table 4.1indicatesthatthe main effect of mental ability on students' achievement in genetic concepts in Biology($F_{(2,\ 361)}$ =0.93; p>0.05, partial η^2 = 0.01) was not significant. Thus, hypothesis 2a was not rejected. This implies that mental ability had no effects on students' achievement in genetic concepts in Biology.

Table 4.10: Estimated Marginal Means for Posttest Achievement Scores by Mental Ability

Mental Ability	Mean	Std Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	17.528	.602	16.344	18.712
Medium	16.654	.448	15.773	17.536
Low	16.430	.656	15.140	17.720

Table 4.10 revealed that students with high mental ability had the highest adjusted mean score ($\bar{x} = 17.528$), followed by the students with medium mental ability ($\bar{x} = 16.654$), while the students with low mental ability had the least adjusted mean score ($\bar{x} = 16.430$), the difference was not significance.

4.1.2Ho2b: There will be no significant main effect of mental ability on students' attitude to genetic concepts in Biology.

Table 4.4reveals thatthere is no significant main effect of mental ability on learners' attitude to genetic concepts in Biology($F_{(2, 361)} = 1.12$; $p > 0.05$, partial $\eta^2 = 0.01$). Thus, hypothesis 2b was accepted. This implies that mental ability had no effect onstudents' attitude to genetic concepts in Biology.

Table 4.11: Estimated Marginal Means for PosttestAttitude by Mental Ability

Mental Ability	Mean	Std Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	55.207	1.031	53.180	57.235
Medium	54.113	.777	52.584	55.645
Low	52.916	1.141	50.670	55.161

From table 4.11 high mental ability students had the highest adjusted mean score ($\bar{x}$ =55.207), followed by the students with medium mental ability ($\bar{x}$ =54.113), while the students with low mental ability had the least adjusted mean score ($\bar{x}$ =52.916), the difference was not significance.

4.1.2Ho2c: There will be no significant main effect of mental ability on students' science process skills acquisition in genetic concepts in Biology.

Table 4.7 shows thatthe main effect of mental ability on students' science process skills acquisition in genetic concepts in Biology ($F_{(2, 361)}$ =1.00; p>0.05, partial η^2 = 0.01) is not significant. Thus, hypothesis 2c was not rejected.

Table 4.12: Estimated Marginal Means for Science Process Skills Acquisition by Mental Ability

Mental Ability	Mean	Std Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	55.089	1.171	52.786	57.392
Medium	55,721	.878	53.994	57.449
Low	53.519	1.285	50.990	56.047

Table 4.12 revealed that students with medium mental ability had the highest adjusted mean score ($\bar{x}$ =55.721), followed by the students with high mental ability ($\bar{x}$ = 55.089), while the students with low mental ability had the least adjusted mean score ($\bar{x}$ =53.519), but the difference was not significance.

4.1.3Ho3a: There will be no significant main effect of learning style on students' achievement in genetic concepts in Biology

Tab.4.1 reveals thatthere is no significant main effect of learning style on students' achievement in genetic concepts in Biology ($F_{(2, 361)}$ =0.33; p>0.05, partial η^2 = 0.00). Hence, hypothesis 3a was accepted.

Table 4.13: Estimated Marginal Means of Posttest Achievement Scores by Learning Style

Learning Style	Mean	Std Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Auditory	16.877	.658	15.582	18.173
Visual	17.172	.519	16.151	18.193
Kinesthetics	16.563	.535	15.511	17.615

From table 4.13 Visual learning style students had the highest adjusted mean ($\bar{x}$ =17.172), followed by their counterpart with auditory learning style ($\bar{x}$ =16.877), while the kinesthetics learning style students had the least adjusted mean ($\bar{x}$ =16.563), but the difference was not significance.

4.1.3Ho3b: There will be no significant main effect of learning style on students' attitude to genetic concepts in Biology.

The ANCOVA in Table 4.4reveals thatthe main effect of learning style on students' attitude to genetic concepts in Biology ($F_{(2, 361)}$ =0.30; p>0.05, partial η^2 = 0.00) is not significant. Thus, hypothesis 3b was accepted.

Table 4.14: Estimated Marginal Means of Posttest Attitude Scores by Learning Style

Learning Style	Mean	Std Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Auditory	54.353	.1.134	52.121	56.584
Visual	53.489	.897	51.724	55.254
Kinesthetics	54.394	.921	52.583	56.205

From table 4.14 Kinesthetics learning style students had the highest adjusted mean ($\bar{x}$ =54.394), followed by their counterpart with auditory learning style ($\bar{x}$ =54.323), while the visual learning style students had the least adjusted mean ($\bar{x}$ =53.489)), but the different was not significance.

4.1.4Ho3c: There will be nosignificant main effectof learning style on students' science processskills acquisition in genetic concepts in Biology.

Tab. 4.7shows thatthe main effect of learning style on learners' scienceprocess skills acquisition in genetic concepts in Biology ($F_{(2, 361)}$ =0.05; p>0.05,partial η^2 = 0.00)is not significant. Thus, hypothesis 3c was not rejected.

Table 4.15: EMM of Posttest Science Process Skills Acquisition Scores by Learning Style

Learning Style	Mean	Std Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Auditory	54.914	1.286	52.384	57.444
Visual	54.906	1.017	52905	56.907
Kinesthetics	54.509	1.046	52.451	56.566

From table 4.15Auditory learning style students had the highest adjusted mean ($\bar{x}$ =54.914), followed by the students with visual learning style ($\bar{x}$ =54.323), while the kinesthetics learning style students had the least adjusted mean ($\bar{x}$ =53.906)), but the difference wasnot significance.

Interaction Effects ofTreatment and Mental Ability

4.1.4Ho4a: There will be nosignificant interaction effectof trtmt and mental ability on students' achievement in genetic concepts in Biology.

The ANCOVA in Tab.4.1indicates that the 2-way interaction effect of treatment and mental ability on students' achievement in genetic concepts Biology was significant ($F_{(4, 361)}$ =3.89; $p<0.05$, partial $\eta^2 = 0.05$). The effect is 5.0%. This meansthat 5.0% of the total differencein students' post-achievement scores in genetic concepts Biology was due to the 2-way interaction effect oftreatment and mental ability on students' achievement in genetic concepts Biology. Therefore, hypothesis 4a was rejected. This implies that treatment and mental ability had effect on students' achievement in genetic concepts in Biology. In order to explore the 2-way interaction effect of treatment and mental ability, Fig. 4.1 shows the interaction effect in line graph.

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Fig.4.1: Treatment and Mental Ability on Students' Achievement in Genetic Concepts in Biology.

Fig4.1: **Treatment and mental ability on students' achievement in genetic concepts Bology.**

Figure 4.i indicates that high mental ability learners in the Mind Mapping Strategy have the highest post-achievement in genetic concepts in Biology mean score ($\bar{x}$ =21.49),followed by their counterparts with medium mental ability students in the Mind Mapping Strategy ($\bar{x}$ =18.71), medium mental ability students in the Gallery Walks Strategy ($\bar{x}$ =18.33), low mental ability students in the Mind Mapping Strategy ($\bar{x}$ =17.82), low mental ability students in the Conventional Strategy ($\bar{x}$ =16.11), high mental ability students in the Gallery Walks Strategy ($\bar{x}$ =15.86), low mental ability students in the Gallery Walks Strategy ($\bar{x}$ =15.36), high mental ability students in the Conventional Strategy ($\bar{x}$ =15.24), while medium mental ability students in the Conventional Strategy ($\bar{x}$ =12.93) have the lowest post-achievement in genetic concepts in Biology mean score.The interaction is disordinal. It mean that the both treatment (strategies) and mental ability worked together to produce a joint positive impact on students achievement in genetic concepts in Biology. It also means that, based on mental ability, it is not the same group of students across treatment groups that have better performance in genetic concepts in Biology as far asachievement was concerned

4.1.4Ho4b: There will be nosignificant interaction effect of treatment and mental ability on students' attitude to biology

Tab.4.4 revealed that the 2- ways interaction effect of treatment and mental ability on students' attitude to Biology was notsignificant ($F_{(4,\ 361)}$ =2.05;p>0.05, partial η^2 = 0.02). The effects size of 0.2% was negligible. Therefore, hypothesis 4b was not rejected.

4.1.4Ho4c: There is no significant interaction effect of treatment and mental ability on students' science process skills acquisition in genetic concepts in Biology.

Table 4.7 revealed that there was significant2-way interaction effect of treatment and mental ability onstudents' acquisition of science process skills in genetic concepts in Biology ($F_{(4,\ 361)}$ =3.44; p<0.05, partial η^2 = 0.04). The effect is 4.0% and was negligible. This means that 4.0% of the total variationin students' post-science process skills acquisition scores in genetic concepts in Biology wasas the results of the 2-way interaction effect of treatment and mental ability on students' science process skills acquisition in genetic concepts in Biology. Therefore, hypothesis 4c

was rejected. This implies that treatment and mental ability had positive effect on students' acquisition science process skills in genetic concepts in Biology. In order to explore the 2-way interaction effect of treatment and mental ability. Figure 4.2 presents the 2-ways interaction effects in line graph.

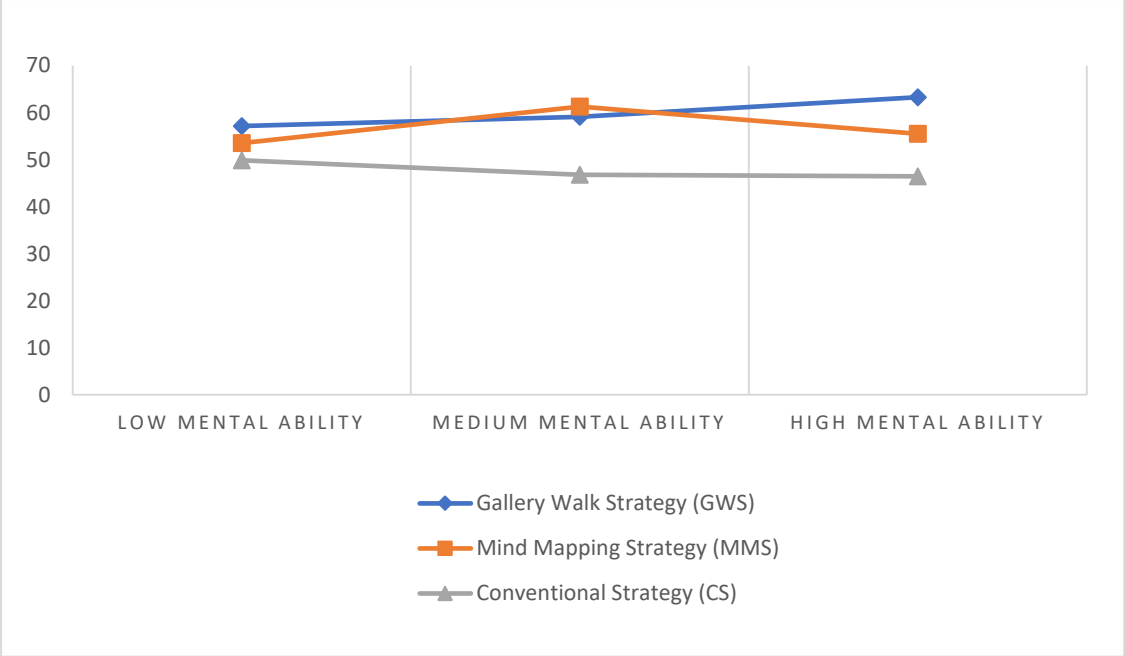


Figure 4.2: Interaction Effects ofTreatment and mental ability on students' science process skills acquisition in genetic concepts in Biology.

Figure 4.2 indicated that high mental ability students in the Galley Walks Strategy have the highest post-science process skills acquisition in genetic concepts in Biologymean score ($\bar{x}$ =63.29), follows by medium mental ability students in the Mind Mapping Strategy ($\bar{x}$ =61.30), medium mental ability students in the Gallery Walks Strategy ($\bar{x}$ =59.10), low mental ability students in the Gallery Walks Strategy ($\bar{x}$ =57.16), high mental ability students in the Mind Mapping Strategy ($\bar{x}$ =55.52), low mental ability students in the Mind Mapping Strategy ($\bar{x}$ =53.53), low mental ability students in the Conventional Strategy ($\bar{x}$ =49.87), mediummental ability students in the Conventional Strategy ($\bar{x}$ =46.77), while highmental ability students in the Conventional Strategy ($\bar{x}$ =46.46) have the lowest post test-science process skills acquisition in genetic concepts inBiologymean score. The interaction is dis-ordinal. It means that the both treatment strategies and mental ability worked together to produce a joint positive impact on students acquisition of science process skills in genetic concepts in Biology. It also, means that based on mental ability, it is not the same group of students across treatment groups that have better performance in genetic concepts in Biology when their acquisition of science process skills in genetic concepts Biology is concerned.

Interaction Effects of Treatment and Learning Style

4.1.5Ho5a: There will be no significant interactioneffect of treatment and learning style on students' achievement in genetic concepts in Biology.

The ANCOVA sin Tab.4.1revealed that there was no significant interaction effect of treatment and learning style on students' achievement in genetic concepts in Biology ($F_{(4, 361)}$ =2.17; p>0.05, partial η^2 = 0.03). The effect size of .3% was negligible. This means that treatmentand learning style had no effect on students' achievement in genetic in Biology. On the basis of this therefore, hypothesis 5a was accepted.

4.1.5Ho5b: There will be no significant interactioneffect of treatment and learning style on students' attitude to genetic concepts in Biology

Tab.4.4revealed that therewas nosignificant interaction effectof treatment and learning style on students' attitude to genetic concepts inBiology ($F_{(4, 361)}$ =0.08; p>0.05, partial η^2 = 0.00). The zero (0.0%) was recorded. This means that treatment and learning style had no effect on students' attitude to genetic concepts in Biology. Therefore, hypothesis 5b was not rejected.

4.1.5Ho5c: There will be no significant interaction effect of treatment and learning style on learners' science process skills acquisition in genetic concepts in Biology.

Tab4.7revealed that there was no significant interaction effect of treatment and learning style on studentss' acquisition of scienceprocess skills in genetic concepts in Biology ($F_{(4, 361)}$ =0.73; p>0.05, partial η^2 = 0.01). The effect size of 1% is negligible. This implies that treatment and learning style had no effect on students' acquisition of science process skills in genetic concepts in Biology. Therefore, hypothesis 5c wasnot rejected.

Interaction Effects of Mental Ability and Learning Style

4.1.6Ho6a: There will be no significant interaction effectof mental ability and learning style on students' achievement in genetic concepts in Biology

Table4.1 showed that theinteraction effect of mental ability and learning style on learners' achievement in genetic conceptsin Biology ($F_{(4, 361)}$ =0.29; p>0.05, partial η^2 = 0.00) was not significant. The size effect of 5% was negligible. Thisindicated that mental ability and learning style had no effect on students' achievementin genetic concepts Biology. Therefore, hypothesis 6a was notrejected.

4.1.6Ho6b: There will be nosignificant interaction effect of mental ability and learningstyle on students' attitude to genetic concepts in Biology

The ANCOVA revealed in Table 4.4 showedthat the interaction effectof mental ability and learning style on students' attitude to genetic concepts in Biology ($F_{(4, 361)}$ =0.41; p>0.05, partial η^2 = 0.01)was not significant. The size effect of 1% was negligible. This meansthat mental ability and learningstyle had no effect on students' attitude to genetic concepts in Biology. Therefore, hypothesis 6b was not rejected.

4.1.6Ho6c: There will be no significant interactioneffect of mental ability and learning style on students' science process skills acquisition in genetic concepts in Biology.

The ANCOVA in Tab.4.7 revealed that the interaction effectof mental ability and learning style on learners' acquisition of science process skills in genetic concepts in Biologywas not significant ($F_{(4, 361)}$ =0.06; p>0.05, partial η^2 = 0.00).This indicates that mental ability andlearning style had no effect onstudents' acquisition of science process skills in genetic concepts in biology. Therefore, hypothesis 6c was accepted.

Interaction Effects of Treatment, Mental Ability and Learning Style

4.1.7Ho7a: There will be no significant interaction effect of treatment, mental ability and learning style on students' achievement in genetic concepts in Biology.

Tab4.1indicated that there was no significant interaction effect of treatment, mental ability and learning style on students' achievement in genetic concepts in Biology ($F_{(8, 361)}$ =0.89p>0.05, partial η^2 = 0.00).This indicates thattreatment, mental ability and learning style had no effect on students' achievement in genetic concepts in Biology. Thus, hypothesis 7a was not rejected.

4.1.7Ho7b: There will be no significant interaction effect of mental ability and learning style on students' attitude to genetic concepts in Biology.

Tab.4.4 revealed that there was no significant interaction effect of treatment, mental ability and learning style on students' attitude to genetic concepts in Biology ($F_{(8, 361)}$ =0.28; p>0.05, partial η^2 = 0.01).The size effect of 1% was negligible. This means that treatmet, mental ability and learning style had no effect on students' attitude to genetic concepts in Biology. Therefore, hypothesis 7bwas not rejected.

4.1.7Ho7c: There will be no significant interactioneffect of mental ability and learning style on students' science processs skills acquisition in genetic concepts in Biology.

The ANCOVA in Tab.4.7 revealed that the interaction effectof mental ability and learning style on students' acquisition of science process skills in biology was significant ($F_{(4, 361)}$ =2.40; p<0.05, partial η^2 = 0.05).The effect is 5.0% was negligible. This means that 5.0% of the total differencein students' post-science process skills acquisition scores in genetic concepts in Biology was as the 3-way interaction effect oftreatment, mental ability and learning style on students' acquisition of science process skills in genetics biology. This indicates thattreatment, mental ability and learning style had effect on students' science process skills acquisition in genetic concepts in Biology. Therefore, hypothesis 7c was rejected. In order to explore the interaction effect, Figure 4.3 presents the 3-way interaction in line graph.

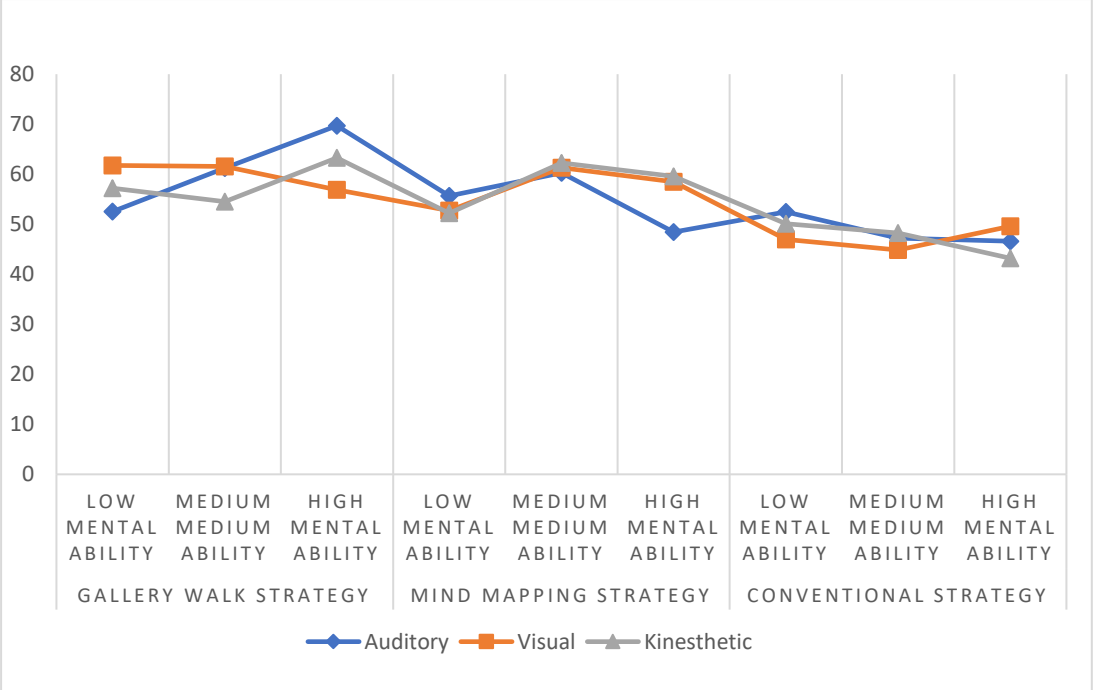


Fig.4.3: Interaction Effects of Treatment, mental ability and Learning style on learners' Science Process Skills Acquisition in Genetic Concepts in Biology

Figure 4.3 indicated that auditory learning style high mental ability students in Gallery Walks Strategy have better post-science process skills acquisition in genetic concepts in Biology mean score ($\bar{x}$ =69.69) follows by their kinesthetics learning style high mental ability students in Gallery Walks Strategy ($\bar{x}$ =63.27), kinesthetics learning style medium mental ability students in Mind Mapping Strategy ($\bar{x}$ =62.28), visual learning style low mental ability students in Gallery Walks Strategy ($\bar{x}$ =61.76), visual learning style medium mental ability students in Gallery Walks Strategy ($\bar{x}$ =61.54), visual learning style medium mental ability students in Mind Mapping Strategy ($\bar{x}$ =61.33), auditory learning style medium mental ability students in Gallery Walks Strategy ($\bar{x}$ =61.25), visual learning style medium mental ability students in Mind Mapping Strategy ($\bar{x}$ =60.28), kinesthetics learning style high mental ability students in Mind Mapping Strategy ($\bar{x}$ =59.57), visual learning style h igh mental ability students in Mind Mapping Strategy ($\bar{x}$ =58.51), visual learning style high mental ability students in Gallery Walks Strategy ($\bar{x}$ =56.91), auditory learning style high mental ability students in Mind Mapping Strategy ($\bar{x}$ =55.66), kinesthetics learning style medium mental ability students in Gallery Walks Strategy ($\bar{x}$ =54.51), visual learning style low mental ability students in Mind Mapping Strategy ($\bar{x}$ =52.70), auditory learning style low mental ability students in gallery walk strategy ($\bar{x}$ =52.55), auditory learning style low mental ability students in Conventional Strategy ($\bar{x}$ =52.50), kinesthetics learning style low mental ability students in Mind Mapping Strategy ($\bar{x}$ =52.23), kinesthetics learning style low mental ability students in Conventional Strategy ($\bar{x}$ =50.11), visual learning style high mental ability students in Conventional Strategy ($\bar{x}$ =49.58), auditory learning style high mental ability students in Mind Mapping Strategy ($\bar{x}$ =48.46), kinesthetics learning style medium mental ability students in Conventional Strategy ($\bar{x}$ =48.23), auditory learning style medium mental ability students in Conventional Strategy ($\bar{x}$ =47.23), visual learning style low mental ability students in Conventional Strategy ($\bar{x}$ =46.99), auditory learning style high mental ability students in Conventional Strategy ($\bar{x}$ =46.61), visual learning style medium mental ability students in Conventional Strategy ($\bar{x}$ =44.85), lastly, kinesthetics learning style high mental ability students in Conventional Strategy ($\bar{x}$ =43.20). The interaction is diordinal. This indicates that based on learning style and mental ability; it is not the same group of students across

the treatments that have better post-science process skills in genetic concepts in Biology.

4.2 DISCUSSION OF FINDINGS

4.2.1a Main Effects of Treatment on Students' Academic Achievement in Genetic Concepts in Biology.

The findings showed a significantmain effect of treatment on students' achievement in genetic concepts in Biology as shown in table 4.1. These findings showed that both strategies (Gallery Walks and Mind Mapping) enhanced student's achievement in genetic concepts in Biology thanthe Conventional Strategy.The result proved and suggested that Mind Mapping Strategy was more effective at improving the students' achievement in genetic concepts in Biology and followed by Gallery Walks Strategy and the Conventional Strategy. Mind Mapping Strategy had a significant effect on student achievement in genetic concepts more than Gallery Walks and Conventional Strategy of teaching. This is due to the fact that students were allowed to participate in various activities of their choice as this enable them to add branch to their map, add very important key words to their map, color code the branches of the map and imaginary the map by putting correct and appropriate image in the map.The effectiveness of Mind Mapping Strategy and that of Gallery Walks strategy over the Conventional Strategy may be due to the fact that Mind Mapping and Gallery Walks Strategies are learner-centered strategy. This may be due to the fact that the two strategies jointly helped the students to create their own knowledge through the experiences.

This study also revealed that students exposed to Mind Mapping Strategy performed better than those exposed to Gallery Walks Strategy by interpretation, thus indicating that Mind Mapping Strategy was more effective. This may be due to the fact that the strategy helped students' to represent words, idea, concept on their own in spider / spiral diagram, hence they generate and acquire knowledge on their own. This finding is in agreement with the submission of Ogundele, (2015) whose discoveries revealed that the students introduced to Mind Mapping Strategy in science (Biology) achieved the main positive change in the scholarly achievement of student when contrasting it with learners exposed to Concept Mapping and lecture method. It uncovered that Mind Mapping is a successful instructing and learning technique for working with student's accomplishment in hereditary concepts in science (Biology).

The results of this research furthermore goes with that of Jibriu *et al (*2012) whose discoveries demonstrated that students who are taught ecological concepts utilizing Mind Mapping Strategy essentially accomplished higher than those taught utilizing lecture Strategy. This demonstrated that educating and learning in by means of constructivist approach is learners focused whereby learners figure out what to realize during learning and construct a new way of understanding information and things around them. The finding is in accordance with affirmation ofAdodo, (2013) who uncovered that Mind Mapping methodology as a self-directed learning (SRL) system assisted with improving learners' presentation in Basic Science learning outcomes and ought to be utilized in the classroom as a superior way to deal with Basic science and Technology for it improved students "basic reasoning capacity" and imaginative abilities. Similarly, teachers should use this strategy to teach other science subject. This result is inline with Gemma, (2009) that Mind Mapping is a suitable educating and learning system for learners to use for sorting out their own thought during reading.

The reason why Gallery walks Strategy is more effective than Conventional Strategy was that it allow active participation of all members of the group and the experiences of students' are valued and they share idea among themselves, this is supported by Nwanekezi *et al,* (2018), David, (2015) and John, (2013). The effectiveness ofboth Mind Mapping and Gallery walk strategies was shown in better performance of students in the achievement posttest score, and improved Science process skills acquisition.

The poor performance of the learners under the control group is because it is teacher-centred. Also, it may be as a result of inadequate science skills on the part of the students and this is peculiar with conventional Strategy. This strategy had been found to be inadequate where the teachers 'teaches the students and the students remains quiet in the course of the teaching, therefore, the learners are made passive recipients of knowledge. The experimentalgroups 1 and II showed no significant differencein their respective mean values although group I1 (Mind Mapping) has higher mean value than the group 1 (Gallery Walks Strategy).

4.2.1b Main Effects of Treatment on Students' Attitude to Biology.

The result has gotten shown a significant main effect of treatment on student's attitude to Biology. Gallery Walks Strategywas more effective than the Mind Mapping strategy and the Conventional Strategy. The effectiveness of Gallery walks Strategy over both Mind Mapping and Convention Strategies may be because of the way that the students were giving opportunity to effectively engage in the learning process. The students were able to get information that will make them acquireknowledge effortlessly and used their skills of understanding; hence they were able to build constructive attitude towards Biology and other students. The finding of this study is in agreement with the submission of Ridwan, (2015) who found out that Gallery Walks successfully make students to be active during teaching and learning process in the classroom. The learners had the option to obtain information easily and used their abilities of seeing; additionally they had the option to develop positive perspective towards the subject and others learners.

The Mind Mapping Strategy was discovered to be more viable than Convetional Method, this might be because of the way that the teacher monitor the students progress in Mind Mapping, provides support and scores are awarded to each student which can serve as reinforcement to them thus change the attitude towards Biology. In the research work carried out by Olagunju and Babayemi, (2014) it was observed that most assumption of the adjustment in teaching is the adjustment of students' mentality towards science (Biology). This is in line with the study of Akinsola (2013),Idowu (2010),Soltani*et al* (2010). However, this finding is opposed to Adesoji (2008) who arguedthat the Conventional Strategy could not be totally abadon. Mind Mapping Strategy shows best positive attitude / favorable attitude which lead to significant / higher attitude in science.

According to Ogundiwin, (2013) an attitude is a way of reasoning, feeling or carrying on that mirrors a perspective or personalityof individual learner. Also, Awolere, (2015) reported that positive attitude is the habitual, mental positioning that characterizes who a learner is. Attitude towards factual science affects course and career choices of thelearners. Attitude takes longer period of time to change just because there are so many factors that must be considered. There are many other factors that may come in as extraneous variables that would not allow an attitude of a learner to be pinned down. Attitude cannot be pinned down. These other extraneous variables can affect learner's attitude.

Attitudes are mental inclinations toward individuals, objects, subjects, occasions, etc. Martin, (2010) found out that in science, mentalities are significant due to three main considerations. Initial, a student's attitude conveys a psychological condition of availability with it. With an inspirational mentality, a student will see science objects, subjects, exercises, and individuals decidedly. A student, who is unready or reluctant, for reasons unknown, will be less able to connect with individuals and things related with science. This availability factor happens unknowingly in a student, without earlier idea or clear assent.Second, attitude aren't inborn or hereditary.According to modern psychology, children's behaviors / characters are learned and modelling by their experiences as they grow up in age (Akinsola, 2013).

Furthermore, since it is not innate, a child's attitude may be influenced by experience.Teachers, parents, and guardians have the biggest impact on students' attitudes toward science (Martin *et al*, 2010). Third, attitudes are diverse outcomes of encounters that serve as guiding influences for a child as he or she embarks on new adventures (Awolere, 2015).As a result, behaviors have an emotional as well as an analytical tone, all of which contribute to decisions and assessments.These choices and assessments can lead to a child's interests and desires shifting.Academic attitude has a huge effect on productivity and academic success.Younger children have an optimistic attitude toward factual sciences, and they demonstrate many of these behaviors when they explore and engage with their peers.However, these initial optimistic attitudes can wane over time (Martin *et al*, 2010). Academic success is aided by a positive attitude, while academic failure is aided by a pessimistic attitude.

A positive attitude is conducive to academic success while negative attitude is counter productive (Cohen, 2013). Everyone in the world is full of some kind of attitudes that someone else in the society may not like.Every learner has a choice in his or her life as to how he or she habitually views things- positively or negatively. If one tries to find out the causes behind the undesirable attitude of the students, one will discover that some of the things that are affecting their attitude are things they can change. The physiological factors and the situations of the learners may affect their attitude even in the classroom. The factors could be illness, stress environment, kind of foods and water taken, weight loss, anxiety, physical activity and many more. People give up too easily because they focus on how far they still have to go rather than how far they have already come. The researcher is not disappointed at the result but hopes to add more factors in the future to have amore positive effect on the students' attitude.

4.2.1c: Main Effects of Treatment on Learners' Science Process Skills Achievement in GeneticConcepts in Biology.

The results obtained in this study revealed that there was significant effect of treatment on students' acquisition of Science Process Skills Acquisition in Biology. The result proved that Gallery Walks Strategy was more effective at improving the students' acquisition of Science Process Skills in Biology, followed by their counterparts in Mind Mapping Strategy and the Conventional Strategy. The effectiveness of Gallery Walks Strategy and that of Mind Mapping over the Conventional Strategy may be due to the fact that Gallery Walksand Mind Mapping Strategies are Students'-centred.Science Process Skills Acquisition are a bunch of extensively adaptable capacities and possibilities fitting to science control and intelligent of genuine conduct of researchers utilized in science class (Okeke *et al*, 2004). The advancement of these science process skills acquisitions is an essential pre-requisite being developed of students scholarly abilities expected to acquire ideas in Biology (Awolere, 2015). They also believed that the science process skills acquisition can increase students' ability to answer questions and solve problems in Biology class.

Ergul *et.al, (*2011) reported that learning science goes beyond obtaining scientific information since it incoorporate the ability to acuquire skills such as the science process skills. They are an important method in teaching science lessons in science class and also is the building-blocks of critical thinking ability skills and promote method of inquiry in science activities. This finding is in line with whose exploration study gave proof that there was topic improvement of Science Process Skills Acquisition and the intellectual mastering interaction of learners. In the initial cycle, the students' SPS arrived at 71.29% and its became 81.2% in cycle II. It is glearing that dynamic training methodology advances SPS in the class. The result furthermore strengthens the result of Karamustafaoglu, (2011) whose survey revealed that the per-service instructors had issues with the pretest and particularly with the integrated process skills acquisition. After the investigation it was seen that the pre-service educators' SPS were expanded just as their integrated process skills issues were vanished.

It suggests that learners need to obtain SPS with the end goal for them to have the option to take care of issues in science class. Learning science lessons by apprehending requires using SPS.This study is also concerned with measuring

students' acquisition of SPS in Biology which include Recording, Observing, Inferring, Graphing, Predicting and Experimenting.

More also, this result is in connection with the finding of Suryan, Harahap and Sinulinga, (2017) who reported that science process skills acquisition of learners instructed with logical request model utilizing Mind Planning was superior to learners educated by regular learning, physical SPS of learners who have basic reasoning capacity utilizing logical request model better than expected better compared to learners who can think basically utilizing traditional models better than expected, and there is the collaboration of logical request learning model utilizing Mind Planning with learners basic speculation capacity in improving understudies' science interaction abilities.

The finding is in consonance with Salah and Mohammad, (2014) whose study found the presence of viable effect on utilization of MP to improve science measure abilities of female understudies of the experimental group. This examination is on the side of Adams, (2016) who researched the impacts of Inquiry Strategy on Secondary school Biology Students' Achievement in Science Process Skills Acquisition in Biu Educational zone, Borno State. The consequences of his discovering uncovered that request based strategy was more compelling in encouraging learners' procurement of SPS than the talk technique. At the point when learners are taught with dynamic learning techniques it will empower learners to be difficult / problem solvers, there by prompting improvement in the learning outcomes of learners in Biology especially in the area of genetic concepts? Experiments help pupils understand theory by experiencing at first hand phenomena such as variations in the shape of ear, nose, face height of an objects etc. Science process skills acquisition is an important means of supporting and extending the learning of all students in a science class. Also, science process skills are always enjoyable and helps keep students interested and motivated. Hence, acquisition of science process skills should be an important part of the curriculum for all science students in senior secondary school in other to promote the advancement of science and technology in Nigeria.

4.2.2a Effects of Mental Ability on Student Achievement in Biology

The result obtained showed that mental ability has nosignificant effect on students' achievement in genetic concepts in Biology Table 4.1. This might be because learnerswith high mental ability learnt better; understood instructions and solved

problems better than those with medium and low mental ability levels. Mental ability in this study does not have positive influence on students' performance in genetic concepts in Biology. The outcomes contradicts the discoveries of Nnorom, (2013) whose discovering found out that learners with high thinking abilities perform better in Science achievement test over the learners who have low skills.The result additionally support the finding of Adeyemi and Awolere, (2016) whose review uncovered that learners with high mental capacity had higher mean score ($\bar{x}$ = 17.55) on ecological topics than those with low mental capacity who has low mean score ($\bar{x}$ =13.60) on ecological topics.

The result is inline with the finding of Oyedeyi, (2011) whose review uncovered that learner's metal capacity improved their accomplishment in science subjects. The outcome additionally, supports the finding of Olagunju, Duyilemi and Adesina, (2013) who observed that the achievement of pre-service teachers in agric-economic was predicted by their mental ability. The finding is likewise in accordance with Olagunju and Chukwuka, (2008) who detailed that mental ability has huge effect on learners' accomplishment.However, the result also negates the study of Ibitoye, (2021) who review the detailed that students' mental ability hasno significant influence onstudents' achievement in senior secondary school Biology.

4.2.2b Effect of Mental Ability on Students' Attitude to Biology

The result showed that the main effect of mental Ability was not significant on students' attitude to Biology. This result is not in line with the findings of Ellah and Achor, (2015), who's highlighted that the high cognitive capacity level learners which are both field reliant and not reliant affect student's perspective toward science. The outcome additionally demonstrates that 71% of the variety in the learners' attitude towards science is because of the differences in their intellectual ability. It was likewise discovered that there was critical contrast between the cognitive level of male and female in science.

The outcome is contradictory to the findings of Bolaji, Ayanwoye, Adesina, Oyeniran and Wahab, (2015) who found out that learners' with high mental capacity level displayed positive perspective towards science. Also, Olagunju and Chukwuka (2008) revealed that mental ability of learners' has critical impact on learners' mentality towards science (Biology).

4.2.2c Effects of Mental Ability onStudents Science Process Skills

From the result obtained and as it is shown in Table 4.7, it was revealed that there was no significant main effect of mental ability on students' acquisition of SPS in Biology. This may not be unconnected with the fact that whatever the mental ability (high, medium or low) of a learner is, the used strategies are very effective to make an enhancement on the post test scores of the learners in respect to the students gainingSPS in Biology. This result corresponds with the report of Ehikhamenor, (2012) but not in line with Irawanto *et al,* (2017) and Oloyede, (2012).

4.2.3a Effects of Learning Style on Students Achievement in Biology

The result obtainedrevealed that learning style has no significant main effect on achievement in genetic concepts in Biology (Table 4.1). This might be because of the way that students learn. In many ways and whatever the type of students learning style (visual, auditory or kinesthetic) they imbibe, the used strategies are highly effective to make an improvement on the post-test scores of the learners in their achievement in Biology. This result is not in line with Pavol, et al, (2017) Ibe's, (2015), Norasyikini *et al,* (2015) Okoye, (2014), and Godwin *et al,* (2013),

4.2.3b Effects of Learning Style on Learners' Attitude to Biology

The ANCOVA in Tab.4.4 revealed that there was no significant main effectof learning style on learners' attitude to Biology. However, the findings differ from other learning style related research findings such as Wang *et al,* (2015) they found that learning style promote learning attitude in Biology. This may be due to the fact that a single factor cannot determine the learner attitude to Biology.

4.2.3c Effect of Learning Style on Student Science Process Skills Acquisition in Biology

The result exposed that there was no significantmain effect of learning style on students' science process skills (Table 4.7).However, learning style influence on the acquisition of science process skills has generated much concern among researchers. There has been a mixed result for learning style on students acquisition of science process skills in Biology with visual and sequential learning style as good types of learning style (Ling *et al,* 2017), reflective and sensing learning style (Godwin *et al,* 2013). The finding disagrees with their reports.

4.2.4a Two-way Interaction Effects of Treatment and Mental Ability on Learners' Academic Achievement in Biology

The results obtained from the study in table 4.1 revealed that there was significant interaction effect of treatment and mental ability on students' academic achievement in genetic concepts in Biology.

The highest contribution to the significance came from mind mapping strategy high mental ability students while the least contribution came from conventional strategy medium mental ability students.These might be ascribed to the idea of the mind planning technique which permitted the learners to build their own insight into the ideas (hereditary qualities) chose for the investigation as they separately utilize their deduction abilities to review realities and use it to draw their own spiral diagram of the genetics. This fact is supported by the finding of Awolere, (2015) and Gemman, (2009). It's also suggested that students could find Mind Mapping to be a better tool for organizing their own thoughts during class revision and personal research.

The overall goal of considering mental ability is for the test to be able to distinguish between participants of high and low ability. Also, there is a strong link between some analytical abilities assessed by learners' academic performance and intelligence tests. Furthermore, cognitive skills testing are a test of a student's mental capacity. This research result corroborate with the finding of Adeyemi *et al*, (2016) and Nnorom, (2013) where students with high mental ability perform better in Biology achievement test than low mental ability students.

In a study like this, the value of mental capacity cannot be overstated.The word "general mental capacity" refers to a person's ability to learn, comprehend instructions, and solve problems.The single best indicator of a student's academic performance/achievement has been discovered to be general mental capacity.According to research, students with higher grades are more likely to succeed. According to studies, students with higher general mental abilities gain more academic knowledge and do so faster.Higher academic expertise leads to improved results (Sethi, 2010).

Students' success in Biology has been found to be affected by their mental abilities (Olagunju and Chukwuka, 2008 and Awolere, 2015).The overall goal of considering mental ability is for the test to be able to distinguish between participants of high and low ability. It was discovered that there is a strong link between certain analytical abilities as assessed by learners' academic success and intelligence tests. The ability to

communicate in a foreign language is related to academic achievement.Furthermore, measuring cognitive abilities is a test of a student's mental capacity.

4.2.4b Two-way Interaction Effects of Treatment and Mental Ability on Learners Attitude to Biology.

This result suggests that whatever the level of student mental ability e. i (high medium or low) it does not really matter but the strategies used. In other words both Gallery Walk and mind mapping strategies are very effective in teaching Biology; with Gallery walk been most effective followed by mind mapping strategy and the least way conventional strategy, in that order. The result is in line with Awolere, (2015) but not in agreement with Ellah *et al,* (2015) and Bolaji *et al,* (2015) who all found that mental ability have shown that depending on the techniques and materials used for teaching, students with differing levels of mental capacity perform differently.

4.2.4c Two-way Interaction Effect of Treatment and Mental Ability on Students' Science Process Skills Acquisition in Biology

The results obtained from the research study revealed that there was significant interaction effect of treatment and mental ability on students' science process skills acquisition in genetic concepts in Biology. This can be seen in Tab 4.7.

The highest contribution to the significance came from Gallery WalksStrategy high mental ability students while the least contribution came from conventional strategy high mental ability students. This result is in support of Irawan et al, (2017), Oloyede (2012) and Ogundiwin, (2013)

Nonetheless, the finding of this research work is not in line with Ogundiwin, (2013) who asserted that cognitive ability of learners has no critical effect on acquiring science process skills. Likewise, the outcomes negate the discoveries of Awolere, (2015) who tracked down that mental ability has no huge effect on learners' results in Science Process Skills Acquisition in Biology. This outcome isn't on the side of Irawan *et al,* (2017) who announced that learners with high scientific reasoning gained low degree of Science Process Skills

4.2.5a Two-Way Interaction Effect of Treatment and Learning Style ofStudents' Academic Achievement in Genetic Concepts in Biology.

The results obtained from the study showed that there was nosignificant interaction effect of treatment and learning style on student academic achievement in Biology. This is seen according to Table 4.1.

With Mind Mapping Auditory Learning Style been most effective followed by Gallery Walks Visual Learning Style and lastly the conventional kinesthetic learning style in that order. The result is not in line with Okoye, (2014), who affirmed that learning style has effect on students'achievement in science. The outcome contradicts the finding of Akinbobola, (2015) who's affirmed that learning style have critical effect on students' scholastic accomplishment in science. This outcome assert the discoveries of Godwin *et al,* (2013) whose review detailed that learners learning style has no huge impacts on learners' scholarly accomplishment in science. This outcome isn't in accordance with the finding of Norasyikini *et al,* (2015) who detailed that proper learning style assists students with accomplishing great scholarly record in any subject learned in school. The aftereffect of this investigation is in concurrence with the finding of Ibe's, (2015) who announced that learning style didn't effectly affect learners' accomplishment in science.

4.2.5b. Two-way Interaction Effectof Treatment and Learning Style on Learners' Attitude to Biology

The results obtained from research study revealed that there wasno significant interaction effect of treatment and learning style on learners' attitude to Biology. This can be seen in Table 4.4.This result suggests that whatever the types of learning styles students have (visual, auditory or kinesthetic), it does not really matter but the strategies used. In other words both Gallery Walks and Mind Mapping Strategies are very effective to teaching and learning of Biology; with Gallery Walks been most effective followed by the mind mapping and lastly the Conventional Strategy in that order. The result is not in line with the works of Wang *et al,* (2015).

4.2.5c Two-way Interaction Effect of Treatment and Learning Style on Students' Science Process Skills Acquisition in Biology

The outcomes showed that there wasno significant main effect of treatment and learning style on student science process skills acquisition. This is seen according to Table 4.7.

This result suggests that whatever the type of learning styles of students (Visual, auditory or Kinesthetic), it does not really matter but the strategies used. However both Gallery Walks and Mind Mapping Strategies are highly effective for teaching of genetics concepts in Biology with the Gallery Walks been most effective strategy followed by Mind Mapping, and least strategy is Conventional Strategy; in the order. The result is not in line with the worksof Meltem and Godwin *et a,l* (2013) whose

review detailed that learners learning style has no huge impacts on learners' scholastic accomplishment in science. This outcome isn't in accordance with the finding of Norasyikini,*et al*, (2015) who detailed that suitable learning style assists students with accomplishing great scholarly record in any subject learned in school. The aftereffect of this investigation is in concurrence with the finding of Ibitoye, (2021) who revealed that the connection impacts of treatment and learning style didn't have any huge consequences for learners' science practical skills in Science.

4.2.6a Two-way Interacton Effect of Mental Ability and Learning Style onStudents' Academic Achievementin Biology.

The results obtained from the study revealed that there was no significant interaction effect of mental ability and learning style on students' academic achievement in genetic concepts in Biology. This can be seen in Table 4.1.

This result suggest that whatever the level of mental ability (High, medium or low) and whatever the types of learning style is (visual, auditory or Kinesthetic) it does not really matter but the strategies used (Gallery Walks, Mind Mapping and Conventional).The effect of treatment recorded on students achievement as shown by their mean scores greatly enhanced their achievement in Biology with Gallery Walks been most effective, followed by Mind Mapping and lastly, the conventional strategy, in that order. The result is not in line with Awolere, (2015), Adeyemi *et al*, (2016), Okoye, (2014) whose discoveries uncovered that learners learning style has positive impact on their scholarly performance in the subject. in addition, the outcome is in concurrence with the finding of Ibitoye, (2021) who declared that students mental ability and learning style has no huge impacts on learners scholastic accomplishment in Biology.

4.2.6b Two-way InteractionEffect of Mental ability and learning Style on Students' Attitude to Biology.

The results obtained from the study as shown in Table 4.4 revealed that there was nosignificant interaction effect of mental ability and learning style on student attitude.This result suggests that whatever the mental ability of the student be (high, Medium or low) and irrespective of their learning styles (visual, auditory or kinesthetic) what really matter is the strategies used (Gallery Walks, Mind Mapping and Conventional Strategies). The treatment given greatly was found to be effective in teaching genetic concepts in Biology with Gallery Walks Strategy been most effective

followed by the Mind Mapping Strategy and lastly the Conventional Strategy, in order. The result is not in line with Wang *et al*, (2015) and Bolaji *et al*, (2015).

4.2.6c Two-way InteractionEffect of Mental Ability and Learning Style on Learners' Science Process Skills Acquisition in Genetic concepts in Biology.

Theresults obtained from the study as shown in Tab.4.7 revealed that there was no signifcant interaction effect of mental ability and learning style on students' science process sklls acquisition in genetic concepts in Biology.

This result suggests that the mental ability of the students (high, medium or low) and whatever the learning styles of the students be (visual, auditory or kinesthetic) do not really matter but the strategies used (Gallery Walks, Mind Mapping or Conventional). What really determined their improvement in the acquisition of their science process skills in genetic concepts in Biology is their exposure to the appropriate types of instructional strategies with Gallery Walks been most effective, followed by the Mind Mapping and lastly Conventional Strategy, in that order.

This result disagrees with the findings of Irwanto *et al* (2017), Oloyede, (2012)and Meltan *et al*, (2011). The result concur with the finding of Ibitoye, (2021) who revealed that interaction mental ability and learning style dd not has significant positive effects on students acquisition of science practical skills.

4.2.7a three-way Interaction Effectof Trtmt, Mental Ability and Learning Style on students Achievementin Biology.

The result obtained from the study (Table 4.1) revealed that a three way interaction effect of treatment, mental ability and learning style on students Academic Achievement in genetic concepts in Biology, was not significant. This result suggests that mental ability (high, medium or low) and leaning style (visual auditory or kinesthetic), do not really matter but the strategies used (Gallery Walks, Mind Mapping or Conventional). What really determined their improvement in the academic achievement in genetic concepts in Biology is their exposure to the most suitable type of instructional strategies with Gallery Walks Strategy been most effective, followed by the Mind Mapping and lastly the Conventional, in that order.

The result is in support of the findings of Awolere, (2015) but it disagree with the findings of Adeyemi *et al*, (2016), Ibe's, (2015) and Okoye, (2014).

4.2.7b Three-way InteractionEffect of Treatment, Mental Ability and Learning Style on students' Attitude to Biology

The result obtained from the study (Table 4.4) revealed that a three way interaction effect of treatment, mental ability and learning style on students' attitude to Biology was not significant.

The result suggests that the student mental ability (high, medium or low) and whatever types of learning style of the students be (visual, auditory or kinesthetic), do not really matter but the strategies used (Gallery Walks, Mind Mapping or Conventional). What really matters is their exposure to the suitable type of instructional strategies with Gallery Walks been most effective followed by the Mind Mapping and lastly the Conventional in order.

This result disagrees with the findings of Ellah *et al,* (2015) Norasyikin et al, (2015) and Okoye, (2014)

4.2.7c Three-way Interation Effect of Treatment, mental, Ability and Learnng Style on Students' Science Process Skills Acquisition in genetic concepts in Biology

The results obtained from the study Tab.l4.7 revealed that there was a significant interaction effect of treatment mental ability and learning style on students'science process skills acquisition in genetic concepts in Biology, the highest contribution to the significance came from Gallery Walks high mental ability auditory leaning style learners while the least contribution came from conventional high mental ability kinesthetic students.

This finding is in support of Norasyikin *et al,* (2015) who found that learning style helps students to achieve good academic record in science class, Okoye, (2014) also discovered that learning style has significant influenced on the achievement of the student in Biology.

4.3 Summary of Findings

Based on the analysis and the interpretation of the data collected in the study, findings are summarized as follow;

1. There was significant main effect of treatment on students' academic achievement, student's attitude to Biology and students science process skills acquisition in genetic concepts in Biology

2. There was no significant main effect of mental ability on students' academic achievement, student's attitude to Biology and science process skills in genetic concepts in Biology.
3. There was no significant main effect of learning style on students' academic achievement, students' attitude to Biology and science process skills acquisition in genetic concepts in Biology.
4. There was significant interaction effect of treatment and mental ability on students' academic achievement in Biology and students' science process skills aquisition in genetic concepts in Biology. Also, the interaction effect of treatment and mental ability on students' attitude to Biology was not significant.
5. There was no significant interaction effect of treatment and learning style on students' academic achievement, students' attitude to and students' science process skills acquisition in genetic concepts in Biology.
6. There was no significant interaction effect of mental ability and learning style on students' academic achievement, students' attitude to and students' science process skills aquisition in genetic concepts in Biology
7. There was no significant interaction effect of treatment, mental ability and learning style on student academic achievement in Biology, and students' attitude to genetic concepts in Biology. Also, the interaction effect of treatment, mental ability and learning style on students' science process skills acquisition in genetic concepts in Biology was significant.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the study

The study investigated the effects of Gallery Walks and Mind Mapping Strategies on students' academic achievement, attitude to and science process skills acquisition in genetic concepts in Biology in Kwara State, Nigeria. The study also examined the moderating effects of mental ability of the participants and their learning style on students' achievement, attitude and science process skills acquisition in genetic concepts in Biology.

The research design used was pretest-posttest control group, quasi-experimental design making use of a 3 x 3 x 3 factorial matrix.

Three hundred and sixty four SS 11 Biology students from nine randomly selected intact classes participated in the study. The nine schools were randomly selected from three randomly selected local government areas of Kwara state. Genetic concepts were used for the study.

In order to collect data, nine instruments were used for the study. They are:

1. Genetic Concept in Biology Achievement Test (GCBAT)
2. Students Attitude Toward Biology Scale (SATBS)
3. (a) Biology Students Science Process Skills Acquisition Scale (BSSPSAS)

(b)Biology Students Science Process Skills Acquisition Rating Scale

(BSSPSARS)

4. Biology Students Mental Ability Test (BSMAT)
5. Biology Students Learning Style Test (BSLST)
6. Teachers' Guide on Gallery Walk Strategy(TGGS)
7. Teachers' Guide on Mind Mapping Strategy(TGMS)

8. Teachers' Guide on Conventional Strategy(TGCS)
9. Evaluation Sheet for Assessing Teachers'Performance during Training.

   (ESATPDT)

   a. Gallery Walks Strategy (ESATGS)
   b. Mind Mapping Strategy (ESATMS)
   c. Conventional Strategy(ESATCS)

The study made use of the following work schedule:

One (1) week was used for the visitation to the schools

Three (3) weeks were used for training of teachers (research assistants) and scruting

One (1) week was used for the administration of Pre-test (all instruments)

Eight (8) weeks were used for treatment making use of the training research assistants on the listed strategies of teaching. The treatment took place at the same time in all the selected schools.

One(1) week, been the last week was used for the administration of posttest. In all, the study lasted for fourteen (14) weeks. However, seven null hypotheses were raised and tested at 0.5 level of significance.

The collected data were analyzed using Analysis of Covariance (ANCOVA),

Estimated Marginal Mean (EMM), Bornferroni posthoc test and finally graphs was to explain interaction effect.

Based on the analysis and the interpretation of the data collected in the study, findings are summarized as follow;

1. There was significant main effect of treatment on students' academic achievement, student's attitude to Biology and students science process skills acquisition in genetic concepts in Biology.
2. There was no significant main effect of mental ability on students' academic achievement, student's attitude to Biology and science process skills in genetic concepts in Biology.

3. There was no significant main effect of learning style on students' academic achievement, students' attitude to Biology and science process skills acquisition in genetic concepts in Biology.

4. There was significant interaction effect of treatment and mental ability on students' academic achievement in Biology and students' science process skills aquisition in genetic concepts in Biology. Also, the interaction effect of treatment and mental ability on students' attitude to Biology was not significant.

5. There was no significant interaction effect of treatment and learning style on students' academic achievement, students' attitude to and students' science process skills acquisition in genetic concepts in Biology.

6. There was no significant interaction effect of mental ability and learning style on students' academic achievement, students' attitude to and students' science process skills aquisition in genetic concepts in Biology.

7. There was no significant interaction effect of treatment, mental ability and learning style on student academic achievement in Biology, and students' attitude to genetic concepts in Biology. Also, the interaction effect of treatment, mental ability and learning style on students' science process skills acquisition in genetic concepts in Biology was significant.

5.2 Conclusion

The results of this study showed that Gallery Walk and Mind Mapping Strategy were more successful than traditional or conventional teaching strategies in improving students' academic achievement in Biology, their attitude toward Biology, and their acquisition of science process skills in genetic concepts in Biology.This was due to the fact that both instructional methods improved criticaBoth methods were student-centered, with students thinking, actively participating in learning activities, and effectively interacting with one another.When these methods were used to teach genetics problems in Biology, students demonstrated a higher degree of engagement and interest in solving the problems.The two strategies have motivated students to take an active role in learning genetics concepts As a result, the students were able to solve Biology problems...

Furthermore, the two strategies made teaching and learning flexible and developed the spirit of cooperation towards effective learning among the learners. Use of, the two strategies, either singly or jointly showed that learners academic achievement in

Biology, students attitude to Biology and learners scence process skills in Biology irrespective of mental ability and learning style could be improved. The two strategies also promoted students' participation in the classroom as they learned through learner-centred strategies.

5.3 Educational Implications

The openness of the students to gallery walk and mind mapping have been found to emphatically influence the improvement of learners accomplishment (achievement), learners disposition to science and gaining of science process skills acquisition in genetic concepts in Biology. The discoveries have shown the significance of utilizing strategies that are participatory and students centered, where students are prepared to assume responsibility for their learning process.

The research work also showed that there is need for complete participation of students in our system of education and learning procedures. The Gallery Walks and Mind Mapping strategies help the students to comprehend and have holistic knowledge of genetics

Biology instructors should attempt to coordinate in which learners build up their critical thinking capacity. Instructors should take note of learners' degree of mental capacity (high, medium and low) and kinds of learning style (visual, auditory and kinesthetic). The majority of the scholarly issues experienced by learners in learning could be depicted in term of their mental capacity level and kinds of learning style they have; for the mental capacity and learning style defines the achievement of the learner in the school. Consequently unique consideration ought to be given to students' menta capacity and students' learning style corresponding to the selection of systems that the educator will apply in the homeroom.

5.4 Contributions of the Study to Knowledge

This study has contributed to knowledge generally in the following ways:

1. Gallery Walks and Mind Mapping Strategies have been found to be effective at improving students' academic achievement in biology, students' attitude to genetics biology and Students' acquisition of science Process Skills, because of the fact that both strategies are student-centred. This result has therefore provided a basis for curriculum innovation, training and in-service programmes of biology teachers in the field as well

2. Gallery Walks and Mind Mapping Strategies have shown that the two strategies also promote active participation of students to master the genetics concepts in biology; therefore the students were able to solve problems in biology. Due to the fact that the learners were involved in different learning activities, they were able to identify problems and provide appropriate solution for it.
3. Both Gallery Walks and Mind Mapping Strategies made teaching and learning flexible and developed the spirit of cooperation towards effective learning among the learners. The two strategies have also shown to have improved students' academic achievement, students' attitude andacquisition of science process skillsacquisition in genetics concepts in Biology.
4. The Nigerian authors have also been exposed to the two strategies so that they can incorporate the steps into their texts making the use by the biology teaching easy. The various steps in both Gallery Walks Strategy and Mind Mapping Strategy can be incorporated thereby making the texts applicable to individuals, schools, interested groups and the larger societies as a whole
5. Findings of this study serve as part of the contributed efforts made by Nigerian educators to equip students to live effectively in this our modern age of science and technology and to develop positive attitude towards the learning of genetic concepts in Biology.

5.5 Recommendations

From the outcomes obtained and the discussion made, the following recommendations are therefore made:

1. Gallery Walks Strategy and Mind Mapping Strategy should be embraced in the teaching of genetic concepts because of its effectiveness. The strategies involved the students in their learning process and they improved their academic achievement, students' attitude and acquisition of scienceprocess skills needed by students in genetics concept.
2. Biology teachers should make their lessons activity based so that learners can participate in the teaching and learning process. The activities can be in concrete form, experience, abstract conceptualization and active experimentation.

3. There is need for the inclusion of participatory activities which can facilitate learning in the Biology curriculum most especially in teaching of genetics concepts in Biology as this enables learners to create their own experience and construct their own knowledge through the materials available in the class.
4. There should be regular organization of seminars and workshops for biology teachers where the various steps involved in Gallery Walks Strategy and Mind Mapping Strategy would be made known to them
5. It is recommended that biology teachers should make use of Gallery Walks Strategy and Mind Mapping Strategy as they are activity-based and students-centered, hence the quality and quantity of learning will be improved
6. Both Gallery Walk Strategy and Mind Mapping Strategy steps should be integrated into the science curriculum so that the in-service teachers and pre-service teachers can undergo training which would enable them to use two strategies, not only for teaching of genetic concepts in Biology but should be applied to other concepts in Biology. If this is done, more qualified Biology students would be groomed and produced for Biology-related courses in higher institutions of learning.
7. The authors of Biology texts should incorporated the various steps in Gallery Walk Strategy and Mind Mapping Strategy in their texts so as to make them useful, relevant and more applicable to individuals, schools, interested groups and the larger societies.
8. It is also recommended that the Biology education researchers may carry out this research work using larger population and at tertiary institution of learning.

5.6 Limitations of the study

In the course of carrying out this research work, there were constraints that were encountered and these may limit the generalization of the result findings. Some of the limitations are:

1. The geographical scope of this study. The present study was conductedin only nine schoolsin just three randomly selected LGA of Kwara state (Ekiti, Oke-Ero and Irepodun). This calls for replication of the study in a wider population in the state in particular and in the nation at large.
2. Content scope: Only one concept (genetics) was used. More other concepts could still be used.

3. Variable scope: Mental ability and learning style were moderator variables used for this study. However, there are other variables such as parental educational background, school type, gender, school location and so on that could be used.
4. Participant scope: Only three hundredand sixty fve learners participated in the study. This calls for replication of the study in a wider population in the state in particular and in the nation at large

5.7 Suggestions for Further Studies

The following suggestions are made for further studies based on the fact that the researcher conductedthis studyonly in three local governmnt areas of Kwara State. The study could be repeated in secondary schools in other states of the country. The study could also be carried out in other subjects apart from Biology. Biology education researchers may carry out this research work using larger population and at tertiary institution of learning. Other moderator variables such as school types, school location, numerical ability, socio-economic status of the parents, parental background, self efficacy, cognitive style and many more could also be used. Other areas of Biology apart from genetics concepts could also be engade for this will improve the achievement of our learners in biological sciences. Such aspects could be

(i) Ecology and population
(ii) Skeletal and supporting systems
(iii) Cell and cell theory
(iv) Morphological and physiological variations
(v) Transport systems and mechanisms both in plants and animals
(vi) Micro-organisms in action
(vii) Digestive systems and feeding habits
(viii) The sense organs

These are some of the areas or concepts that researchers such as Ojo (2009), Oduwaye (2009), Cimer (2012) and the WAEC Chief examiners' report (2006-2018) have indicated that students' perceive difficult in biology and students' performance has not been encouraging.

REFERENCES

Adam, A. 2016. School effectiveness and school improvement .*An International Journal of Research, Policy and Practice* 27;1

Adegoke, A.2015. Effects of active review and practice-invention instructional strategies on students' attitude to, and achievement and process skills in basic science in Oyo State. Unpublished Ph.d Thesis. University of Ibadan.

Adeyemi, S. B. and Awolere, M. A. 2016. Effects of experiential and generative learning strategies on students' academic achievement in environmental concepts. *Journal of Human Ecology* 56.3:251-262.

Adesoji, F. A.2008. Managing students' attitude towards science through problem-solving instructional strategy. *Journal of Anthropologist*, 10.1:21-24

Adodo, S.O .2013. Effects of mind mapping as a self-regulated learning strategy on students achievement in basic science and technology. *Mediterranean Journal of Social Science.* Published by MCSER – Sapienze University of Rome. 4 .6: 163-172.

Adodo, S.O. and Gbore, L.O. 2012, Prediction of Attitude and Interest of Science Students of Different Ability on their Academic Performance in Basic Science. *International Journal of Psychology and Counseling*.4.6:68-72.

Ajayi, A.C. 2005. Effect of Concept Mapping on Students' Achievement and Interest in Integrated Science, Ph.D. Thesis. University of Ado-Ekiti, Nigeria.

Ajayi, P.O. 2007. Evaluation of the implementation of senior secondary school physics practical activities in Nigeria. *Research in Curriculum Studies.* 5.1: 105-120

Akinbobola A. O. (2015). Effects of Learning Style and Instructional Strategies on Students' Achievement in Nigeria Senior Secondary School Physics. *International Institute for Science ,Technology and Education(IISTE). E. Journals* 41.

Akinsola, M.K. 2009. Comparison of prospective and practicing teacher's mathematics beliefs regarding mathematics teaching and classroom management. In jurgen maaβ and wolfgang schloglmann (Ed) beliefs and Attitudes in Mathematics Education; New research results. Sense publishers, Holland. 135-148.

Akinsola, M.K. 2013. Helping teachers tame underachievement in mathematics. The attitude dimension lead paper presented at the Oyo State mathematical

association of Nigeria conference held at the Trenchard Hall; University of Ibadan, Ibadan Nigeria.

Awolere,S. 2015. Effects of experiential and generative learning strategies on students academi achievement in environmental concepts. *Journal of Human ecology*. 56.3: 251-262.

Azizoglu, N. and Cetin, G. 2009. The effect of learning style on middle schools students' motivation and attitude towards science, and the relationship among these variables *Kastamonu Education Journal*. 17.1:171-182.

Babayemi, J.O.2014: Effects of crossword-picture puzzle and enhanced explicit teaching strategies on students' learning outcomes in basic science in southwestern nigeria- An unpublished Ph.D Thesis, University of Ibadan.

Batdi and Yusuf,.2015. A meta-analysis study of mind mapping techniques and traditional learning methods. *Journal of Anthropologist*. 20.1,2: 62-68.

Barb, Walter, B. and Milone, M. N. 1981. What we know about modality strengthens (PDF). Educational leadership association for supervision and curriculum pevelopment. 378-380.

Biktimirov,E.N. and Nilson, L.B.2006. Show them the money using mind mapping in the introductory finance ourse. *Journal of Financial Education.* 32: 72-86.

Bolaji, O.A, Ayanwale, O.K, Adesina,A.E ,Oyeniran O.J and Wahab R.A 2015. Mental ability,academic self-concept and scientific attitude as predictor of pre-service teachers' achievement in basic general mathematics in Oyo State, Nigeria. *International Journal of Education and Evaluation (IJEE) ISSN* 2489-0073.

Brinkmann, A. 2003. Graphical knowledge display mind mapping and concept mapping as efficient tools in mathematics education. *Mathematics Education Review*. 16;35-48.

Busan,T. and Busan,B. 2000. The Mind map book. London; BBC Boos. Retrieve online. http://www.mind-map.com/EN/

Buzan T. 2005. Mind map handbook. The ultimate thinking test. Retrieve online. http://www.mind-map.com/EN/

Buzan, T and Busan,B. 2005. The Mind Mapping book: Radiant thinking .Busan center. Retrieve online. http://www.mind-map.com/EN/.

Cambridge Dictionary, 2015. Mind map noun- Definition in the British English Dictionary and Thesaurus–Cambridge Dictionaries online. Retrieve on line http://www.dictionarycambridge.org

Chukwuemeka, P.C.2011. Competency-based biology teacher education section reforms in Nigeria. Proceeding of the 52nd Annual Conference Science Teacher Association of Nigeria. 217-224.

Carolyn,P. 2012. Gallery Walks for middle school. NSTA Conference Pennsylvania.http;// www.nsta .org/ Publications / news /Story aspx.

Cimer, A.2012. What makes biology learning difficult and effective.*Students Views Educational Research and Reviews.* 7.3:61-71

Cohen 2013. Research on mental ability and aging. education and educational research source. *Journal Citation Reports.*

Craker, D.E. 2006. Attitudes toward science of students enrolled in introductory level science courses as UW-La Crosse, WU-L *Journal of Undergraduate Research* IX, 1-6.

David, W.R. 2015. Maximize a team based learning Gallery Walks experience ,herding cats is easier than you think . *Advance in Physiology Education*. 39.4: 411-413

Ehikhamenor, E.A. 2012. Effect of two modes of problem solving models on students' achievement and practical skills in practical biology. A Ph.D Post-Field Report in the Department of Teacher Education, University of Ibadan, Ibadan.

Ellah, B. and Achor, E. E. 2015. Cognitive styles and attitude to science of senior secondary school science student of high cognitive ability level. International centre for science humanities and education *Research Journal* (ICSHER Journal). 1.3:10-26.

Ergul, R., Simsekli Y., Calis, S., Ozdilek, Z., Gocmencelebi, S., and Sanli, M. 2011. The Effect of Inquiry-Based Science Teaching on Elementary School Students' Science Process Skills and Science Attitudes. *Bulgarian Journal of Science and Education Policy, 5. 1.*

Esen, U. Ibrahim, B. and Omer, G. 2003. The effect of learning styles on high school students' achievement and attitudes in chemistry. Paper presented at the annual meeting of the national association for research in science teaching (Philadelphia P. a. March 23-26, 2003).

Fasasi ,N, R.A. 2014 Development of an Ethnosciences Database and Its Effects on Students' Learning Outcomes in Basic Science in Southwestern Nigeria. Ph.D Thesis. Department of Teacher Education . University of Ibadan.

Farahaz M., 2012. Improving students' attitude towards science through blended - learning. Department of Biological Sciences. Harold Washington College..

Federal Republic of Nigeria 2013. *National Policy on Education (4th Edition)* .Lagos: NERDC Press

Federal Ministry of Education (2014). National curriculum for Senior Secondary school biology Lagos Government Press

Federal Ministry of Education, 2008. National curriculum for Senior Secondary school biology Lagos Government Press.

Gemma,B. 2009. Use of mind mapping in teaching and learning. The learning institutes assignment.

Godwin, A. I. and Bassey, E. U 2013. Influence of learning styles and teaching strategies on students' achievement in biology. *Voices of Research Working Paper* 1.4;5-13

Goodenough, K.and Woods, R. 2002. Student and teacher perceptions of mind mapping: A middle school case study. Paper presented at the American educational research association Annual Meeting, New Orleans, LA. Retrieved from online.

Huitt, W, 2011. Cognitive development: applications. Educational Psychology Interactive.Valdosta,GA:Valdosta State University.Retrieved online.

Ibe, H. N. 2015. Effects of learning styles on the performances of senior secondary school Biology student. www.researchgate.net International Multidisciplinary *Journal of Education and Research*. 9.1: 214-226.

Ibitoye,T.M, 2021. Project-based Learning and Self-regulatory Strategies as determinants of Secondary School Students' Achievement, Attitudes and Practical Skills in Biology Concepts in Ibadan,Nigeria.Unpublished Ph.D Thesis. University of Ibadan.

Igwe, I.O. 2002. Relative Effect of Framing and Term-assisted Instructional Strategies on Students' Learning Outcomes in Difficult Chemistry Concepts in Parts of Ibadan . Ph.D thesis. University of Ibadan.

Inyang, N.U. and Ekpenyong,H.E.. 2000. Influence of ability and gender grouping on Senior Secondary School Chemistry Students achievement on the concept of reduce reactions. *Journal of Science Teachers' Association of Nigeria,* 35.12: 36-42.

Irwanto, Roheati, E. Widjajanti, E. and Suyanta, 2017. Students' science process skills and analytical thinking ability in Chemistry learning. *IP CoAnference proceedings* .

Jack, G.U .2013. The influence of identified students and school variables on students science process skills acquisition. *Journal of Education and Practice.* 64.5:16-22

Jack,G. U. 2018.Chemistry Students Science Process Skills Acquisition Influence of Gender and Class size . *Globa Research in Higher Education*. 1.1;80

Jibrin, G. A. Sheui, D. Z. Abdullahi, Y. A. (2012). Effects of Mind Mapping Instructional Strategy in Academic Achievement of Senior Secondary School Biology Students' in Ecology. ATBU *Journal of Science, Technology and Education*. 1.2

John, S. 2013. Take digital strategy as a dimension at everything in Tate paper. https://www.fate.org.uk/research/publications/tate-papers/19/tate-digital strategy. (ISSN 1753-9854). Is a peer *Reviewed Research Journal that publishes articles on British and Modern International Art, and On Museum Practice Today.*

Johnson, J.D. and Mighten, A. 2005. Research briefs – a comparison of teaching strategies: lecture notes combined with structured group discussion versus lecture only, *The Journal of Nursing Education.* 44.7: 319-322.

Jonelle,A.B.(1995). Study Skills; Learning to Study through Critical Thinking .Online Version.Chicago.;Irwin Career Education Division

Karamustafaoglu, S. 2011. Improving the science process skills ability of science teachers using diagrams. *Eurasian Journal of Physics and Chemistry Education,* 3.1:26-38.

Keles, O. 2011. Elementary teacher's views on Mind Mapping. International conference on New Horizons in education conference proceedings book, 348. 8-9.

Lawal, F.K. 2011. Biology Teacher Perception of the Senior Secondary Biology Curriculum and the need for reform proceedings of the 52nd -Annual *Conference Science Teacher Association of Nigeria*. 205-209.

Lea,J.S, Stephenson D and Troy, J.k. 2003. Higher education students' attitude to student-centered learning ; beyond 'educational bulima' .*Journal of Studies in Higher Education.* 28;3

Ling, A. S. Basit, A and Hossan, Z. 2017. Does learning style impact student academic performance. *International Journal of Education Learning and Training (IJELT). 2.2.*

Madison, J. 2016. An explanation of learning styles.

Mark, F. 2006. Promoting discussion in the science classroom using gallery walk strategy. Journal of college science. Avaiklable at http;//blog stettson.edu/Jrseminars /wp-content/ uploads /Gallery-Walk .pdf.Retrieve online.

_____2014. Promoting discussion in the science classroom using gallery walk strategy. National Science Teachers Association. Central Michigan University Press.

Mark, F. 2015. What is gallery walks starting point-teaching entry level geosciences. Retrieved on line. .

Martin, M. I. 2015. Effects of mind mapping and experimental techniques in teaching biology in secondary schools in federal capital territory Abuja Nigeria. Unpublished Ph.D dissertation Ahamadu Bello University Zaria.

Martin R, Sexton C., Franklin T.. Gervovich J., McElroy D., 2010: Teaching Science for All Children (with My Education Laboratory); 2010 edition, p 16

Melten, D. Hakan I. Gulcan, M and Oguz, O. 2011. The relationship between the pre-service science teachers' scientific process skills and learning styles. *Western Anatolia Journal of Educational Science (WAJES) Dokuz Eylul University Institute, Izmir,* Turkey. 1:467-476.

Milan, K. 2012. The investigation of teachers' view on the importance of biology skills for lower secondary school pupils. Retrieved on line

Mutiu, M. and Temiz, B.K.2013. Science process skills of students having field dependent and field independent cognitive style. *Education Research Review.* 8 .11):766-776

NABTEB June/July 2012, Chief Exerminer Reports' NABTEB 2012 Biology

NECO June/July 2011, Chief Exerminer Reports' NECO 2011 Biology

NECO June/July 2012). Chief Exerminer Reports' NECO 2012 Biology.

NERD, 2009. Workshop on difficult concepts. biology group report. *Nigeria educational reseach and development council Lagos.*

Norasyikin,O,Mimi,M.M and Aini,N.P.2015. Dimension of learning styles and students' academic achievement . Procedia Social and Behavioral Science.

Nnorom, N. R. 2013. The effect of reasoning skills on students achievement in biology in Anambra State. *International Journal of Scientific and Engineering Research.* 4122102-2104.

National Teachers Institute NTI, 2008. MDG teacher re-training workshop guides for resource persons. Federal ministry of education.

Nwagbo C.R.2008. Practical approach to effective teaching of local and major biotic communities (biomes) to secondary school students' for sustainable development. *S*cience Teachers' Association of Nigeria (STAN) Biology Panel Series 2008. 41-56

Nwagbo, C. and Chukelu, U.C. (2011). Effects Of Biology practical activities On students‟ S cience Process Skills Acquisition. Retrieved online.

Nwanekezi A.U, Walele C. and Eruchi K.S.2018. Effects of gallery walk teaching strategy on the academic performance of students in basic science concepts in Rivers State. *International Journal of Applied Rsearch (IJAR*), 4.12: 253-257

Ogundele, O. 2015. Mind Mapping and Concept Mapping as effective learning tools in biology education. *Proceedings of the 1st interdisciplinary conference of UCC.TASUED* 2015, 27th April, 2015 to 1st May, 2015 at the University of Cape Coast Ghana.

Ogundiwin, O.A. 2013. Effect of pre-theoretic intuition quiz and puzzle-based critical thinking motivation strategies on students learning outcomes in selected environment related concepts, in biology. Unpublished Ph.D Thesis University of Ibadan.

Ogundiwin, O.A. , Asaju, O.A, Adegoke, A.I. and Ojo, A.T. 2015. Effect of group investigative laboratory strategies on students' achievement in Biology. *Pynex Journal of Research in Environmental Studies.* 2.4:35-41.

Okeke Eunice A.C, 2007. Making Science Education Accessible to All. Inaugural Lecture at the Department of Science Education, University of Nigeria, NSUKKA.

Okoye P.O. 2014. Influence of cognitive styles on student's achievements in biology in senior secondary schools, in Anambra State. *An International Journal of Science and Technology*, 3.16:197-207

Olagunju, A.M. 2002. Modern trend in secondary school Biology teaching. Teaching strategies for Nigeria secondary school.power house publisher.187-198.

Olagunju A.M, 2006. Impact of video cd and audio cassette-based instructions on secondary school students' environmental knowledge in selected environmental topic in biology. *Nigeria Journal of Computer (NJCL*). 7.1 ; 37-51.

Olagunju, A,M. and Babayemi J.O.2014. Effects of enhanced explicit teaching (explicit teaching peer tutoring) strategy and gender of students attitude to basic science. *Journal of Education and Leadership Development*, 2:135-150.

Olagunju A.M. and Chukwuka E.U.2008. Effects of moral dilemma and problem solving strategies on students' achievement in conservation waste management ,pollution and over-population concepts in biology. *African Journal of Education Research.* 12.1:56-57

Olatoye, R.A and Adekoya, Y.M. 2010. Effect of project based, demonstration and lecture teaching strategies on senior secondary study achievement in an aspect of agricultural science. *International Journal of Educational Research and Technology.* 1.1:19-29.

Oliver, J,S, and Simpson, R.D.2008. Attitude towards biology and its effects on students achievement. *Science Education Journal*. 6.3:1-16

Oloyede, O. I. and Adeoye,F.A. 2012. The relationship between acquisition of science process skills, formal reasoning ability and chemistry achievement .*International Journal of African and African-American Studies (IJAAS).* 8.1:1-4.

Osborne, J. Simon, S. and Collins, S. 2003. Attitudes towards science. A review of the literature and its implications. *International Journal of Science Education 25.9:1059-1079.*

Osvaido, L.O.2012. Statistical evidence of the correlation between mental ability to compute and students' performance in undergraduate courses.

Pavol, P. Gaye, T. and Julia, C. 2007 . Slovakian students attitudes towards biology. *Gurasian Journal of Mathematics, Science Law Technology Education.* 3:287-295.

Rajshri, V. 2013. Learning style and academic achievement of secondary school learners.

Ramalingam 2007. Modern Biology for Senior Secondary Schools. Onisha Africa FED Publishers Ltd.

Ramesh,M and Patel,R.C, 2013. Critical pedagogy for constructing knowledge and process skills in science. *Journal of Educational Confab*. 1.9: 98-105.

Ridwan, M. 2015. Gallery walk:An alternative learning strategy in increasing students active learning. Journal of english language teaching. Retrieved on line.

Sethi R. J. 2010. *Eurasia Journal of Mathematics, Science and Technology Education,* 6.1. 63-75.

Richard,O. O.O. and Francis, C. I. 2013. Science Process Skills in Kenya Certificate of Secondary Education Biology Practical Examination . Creative Education. 4.11: 713-717.

Salah, A. A. and Mohammed, F. A. 2014. The effect of using mind mapping strategy to improve science process skills in science course on female students of the ninth grade. *Science Journal of Education*, 2: 44-49.

Sallau,I.A. Abubakar,B.B. and Sani,Y. 2018. Biology education a panacea for sustainable national development. *Frontiers in Environmental Microbiology.* 4.2;71-74

Salt K.and Tzougraki,C. 2004. Attitude towards chemistry among 11th grade students achievement in high schools in greece science education. 88.4:533-547.

Scott, R.H and Fisher,D.I. 2006. A malay translation of an elementary school version of the questionnaire on teacher interaction. *Journal of Applied Research in Education.*5:22-34

Sethi R. J. 2010. *Eurasia Journal of Mathematics, Science and Technology Education,* 6.1. 63-75.

Sharon , C. (2008). Feminist Philosophy of Science Standpoint and Knowledge. Science and Education Journal. 17.10.1089-1110

Slavin,R.E, 2005. Cooperative learning student, team, what research says to the teacher (2nd Ed) Washington D.C. national education association social and economic lives of late nineteenth-century butter-makers. Unpublished doctoral dissertation, Cambridge, MA: Harvard University.

Soltani, A. and Nasr, A.R, 2010. Attitude towards biology and its effects on students' achievement. *Proceeding 2nd Paris international conference on education, economy and society,* 2010.

Suaily, H. Utaya, S. and Soetjipto, B. E. 2016. The enhancement of process skills and cognitive learning outcomes of science in elementary school through active learning strategy.

Suryani, A. Harahap, G. and Sinulinga, D. 2017. Investigated the effect of scientific inquiry learning model using mind mapping and on critical thinking ability toward students science process skills in senior high school. *Journal of Research and Method in Education.* 7.5:21-26.

Tamarin, R. H. 2007.Principles of genetics. New Delhi: Tata McGraw-Hill company Ltd

Taylor, P. 2001. Gallary walk. http://www.cct.umb.edu/gallary htm6

Trevino, C. 2005. Mind Mapping and outlining: Comparing two types of graphic organizers for learning seventh-grade life science, Texas Tech University: Unpublished PhD Thesis.

Tungprapa, T. 2015. Effect of using the electronic mind map in the educational research methodology course for master-degree study in the Faculty of Education. *International Journal of Information and Education Technology.*

Vygotsky, L . 1978: Mind in Society: Development of higher physiological process, Cambridge Eds; Harvard press university. 15.1-2:102-110.

WAEC May/June 2000, Chief Exerminer Reports' WASSCE 2000 Biology

WAEC May/June 2003, Chief Exerminer Reports' WASSCE 2003 Biology

WAE-C May/June 2004, Chief Exerminer Reports' WASSCE 2004 Biology

WAEC May/June 2005, Chief Exerminer Reports' WASSCE 2005 Biology

WAEC May/June 2006, Chief Exerminer Reports' WASSCE 2006 Biology

WAEC Nov./Dec. 2006, Chief Exerminer Reports' WASSCE 2006 Biology

WAEC May/June 2007, Chief Exerminer Reports' WASSCE 2007 Biology

WAEC Nov./Dec. 2007, Chief Exerminer Reports' WASSCE 2007 Biology

WAEC May/June 2009, Chief Exerminer Reports' WASSCE 2009 Biology

WAEC May/June 2010, Chief Exerminer Reports' WASSCE 2010 Biology

WAEC Nov./Dec. 2010, Chief Exerminer Reports' WASSCE 2010 Biology

WAEC May/June 2011, Chief Exerminer Reports' WASSCE 2011 Biology

WAEC May/June 2012, Chief Exerminer Reports' WASSCE 2012 Biology

WAEC May/June 2013, Chief Exerminer Reports' WASSCE 2013 Biology

WAEC May/June 2015, Chief Exerminer Reports' WASSCE 2015 Biology

WAEC May/June 2018, Chief Exerminer Reports' WASSCE 2018 Biology

Wang, F. Jang, H. Yang, R. and Weng, C. H. 2015. The influence of teaching style on learning attitude with multi-media teaching material. *Eurasia Journal of Mathematics, Science and Technology Education.* 15.1

Wilson, V.L. Ackerman, C. and Malave, C. 2009. Cross-time attitudes concept formation and achievement in college freshman physics: *Journal of Research in Science Teaching*. 37.10:1112 – 1120.

Yadav, B. and Mishra, S. 2013. A study of the impact of laboratory approach on achievement and process skills in science among is standard students. *International Journal of Scientific and Research Publications* 3.1.

Yara, P. O. 2009. Students' attitude towards mathematics and academic achievement In some selected secondary schools In south western Nigeria. *European Journal of Scientific Research.* 36.3:336-341

Yoloye,T.W.2004. That we may learn better. Inaugural lecture,University of Ibadan, Nigeria.

Zhang, L. and Sternberg, R.J. 2005. The field of style presents three major controversial Issues. Style as Value –Laden Versus Value –Free; Style as Traits versus states and styles as constructs versus similar constructs with different labels .We address these Issues by proposing an integrative model .*Educational psychology review*.

APPENDIX IA

GENETIC CONCEPTS BIOLOGY ACHIEVEMENT TEST (GCBAT)

INTRODUCTION: This test seeks to determine your understanding of genetics concepts in Biology. The result of this test will be kept confidential used for research purpose only.

SECTION A

Personal Data

Name _____ *Sex : Male* ☐ Female ☐

School _____ Age: _____

SECTION B

INSTRUCTION: Choose the correct alternative from option A-D below for each question.

1. Genes are found on ……. (a) Hormone (b) chromosones (c) blood (d) brain
2. An abbreviation for deoxyribonucleic acid (a) DORNA (b) DRA (c) DRNA (d) DNA
3. The DNA strand is held together by ------ bonds between the complementary base pairs (a) weak oxygen (b)weak nitrogen (c) weak Halogen (d) weak hydrogen
4. The sudden change in the structure of DNA is called ------- (a) changing (b) rotation (c)shift (d) mutation
5. The transmission of inherited characters from parent to offspring through genetics know as ---------- (a) genetics (b) heredity (c) phenotype (d) genotype
6. The genetic make-up of an organism is described as its (a) phenotype (b) genotype (c) character (d) allele
7. A character which fails to express itself in the first filia generation but emerges in the second fillia generation is ------- (a) heterozygote (b) homozygote (c) dominant (d) recessive
8. In which of the following is the knowledge of genetics not applicable (a) development of high-yelding varieties (b) preservation of seeds (c)

development of early maturing varieties (d) development of diseases resistant varieties.

9. ---------- is refer to as a father of genetics (a) Charles Darwin (b) Jeans Lamarck (c)Gregor Mendel (d) Robert Hooks

10. Which of the follwing statemnts abut chromosomes is corect?
[a] All the chromosomes of a species are the same in shape [b] The number Present in a species is constant [c] They are neatly arranged in the cytoplas [d] They bear ribosomes on their outer membranes

11. The Fi generation of a cross between a red cock and white hen were all red because the gene for the [a] white colour did not segregate[b] red colour was dominant [c] white colour was dominant [d] red colour was recessive

12. Which of the following diseases can be inherited?
[a] Pneumonia [b] AIDS [c] Sickle cell anaemia [d] Goitre

13. In dihybrid inheritance, Mendel considered [a] a pair of contrasting characters [b] two pairs of contrasting characters [c] three pairs of contrasting characters [d] four pairs of contrasting characters

14. According to Mendel law which state that gene of different trait can segregate independently during the formation of ----------
[a] gene [b] allele [c] gamete [d genotype

15. ---------- State that the likelihood of at least two free occasions happening together can be determined by increasing the individual probabilities of the occasions. [a] Multiplication rule [b] Dominance rule [c]Product rule [d]Mendelian rule

16. According to Mendel second law how many offspring will crossing at second filia generation (fii) produce ? (a) 16 (b) 8 [c] 12 [d] 4.

17. Which of the following statements about sex-linked characters is not true? [a]They are usually borne o the X-chromosome [b] They are more common in males [c] Males are usually carriers [d] They are not usually carried on the Y chromosomes

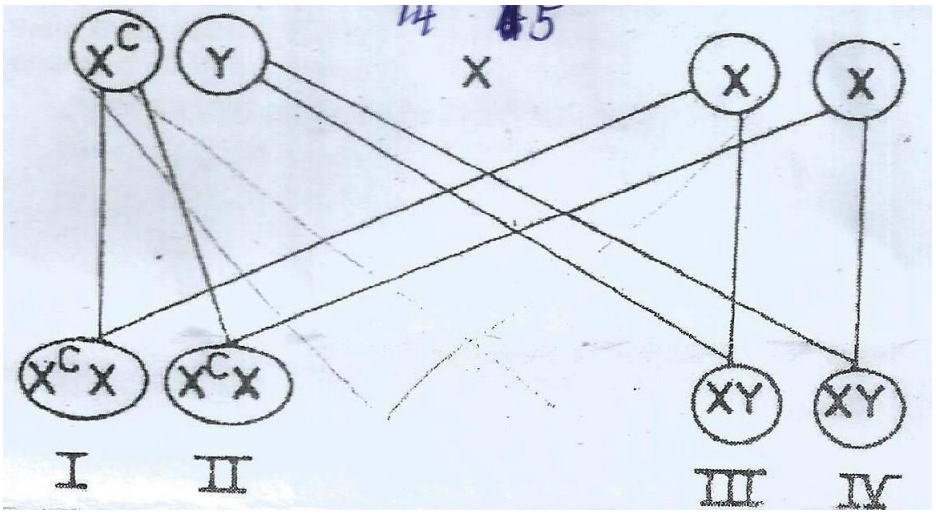
18. Which of the following traits is not inheritable? Ability to [a] taste PTC [b] roll the tongue [c] move the ear [d] roll the eyeball

19. A woman with blood group A gives birth to a child with blood O. Which of the following blood groups cannot belong to the father?
[a] A [b] B [c] AB [d] O

20. How many chromosomes will be in a gamete if the normal cell has four chromosomes?[a] 2 [b] 4 [c] 6 [d] 8

21. A cross between two parents produced four offspring with blood groups AB, BB, BO and AO. What is the blood group of their parents?
[a] AA and BO [b] BB and AO [c] AB and BO [d] B and A

The illustration below represents a cross between a colour – blind male and a normal female. Study it carefully and answer questions 22 and 23



22. What is the genotypic ratio of carrier female to normal males in the cross?
[a] 1:1 [b] 2:3 [c] 3:4 [d] 4:1

23. Which of the genotypes are carriers of colour blindness? [a] I and II only [b] I and III only [c] II and III only [d] I, II and III only

24. Scientists who study genetics are know as…….[a] genealogists [b]Geneticists [c] mendelists [d] generscientists

25. Accepting that An is the quality for typical skin tone and is predominant, while an is the quality for albinism and its passive, what is the probable genotype of the couple which had half ordinary and half pale skinned person off-spring?
[a] AA, aa [b] Aa, aa [c] AA, Aa [d] Aa, Aa

Two unconscious patients X and Y whose blood groupgenotypes are AO and AB individually were bonded with blood from a similar giver. Patient X quickly gave indications of trouble in breathing while patient Y showed no adverse response.No 26 and 27.

26. Patients X and Y were likely moved with blood of genotype

[a] OO [b] AO [c] BO [d] AA

27. What should the clinic have done to keep patient X from showing the manifestation portrayed previously? Patient X ought to have

[a] undergone an agglutination test [b] been requested the blood bunch [c] been screened for HIV [d] Undergone malaria test

28. During gamete formation, the ----------for each gene segregate from other so that each gamete carries only one allele for each gene.

[a] gene [b] allele [c] gamete[d] genotype

29. The trading of qualities between homologous chromosomes is called

[a] crossing over [b] back cross [c] test cross [d] mutation

30. According to Mendel first law, how many offspring will crossing at second filia generation produce ? [a] 16 [b] 8 [c] 12 [d] 4

Study the below punnet square carefully and answer question 31 and 32

X	T	T
T	TT	Tt
t	Tt	tt

31. Calculate the probability of heterozygous tall

[a] 1/4 [b] 1/3 [c] ½ [d] 1

32. Find the probability of dominant tall [a] ½ [b] 1 [c] ½ [d]1/4

APPENDIX IB

MARKING GUIDE FOR GENETIC CONCEPTS IN BIOLOGY ACHIEVEMENT TEST (GCBAT)

1. B
2. D
3. D
4. D
5. B
6. B
7. B
8. B
9. C
10. C
11. B
12. C
13. B
14. C
15. C
16. A
17. C
18. A
19. D
20. A
21. C
22. A
23. A
24. B
25. C
26. D
27. A
28. B
29. A
30. A
31. C
32. D

APPENDIX IIA

STUDENTS ATTITUDES' TOWARDS BIOLOGY SCALE (SATBS)

The purpose of this questionnaire is to let students express their feelings about Biology as a subject. This is not a test and no expression will be marked right or wrong.

SECTION A: PERSONAL DATA

School:_____

Class:_____Age:_____Sex: Male ( )Female ( ) (Tick as appropriate)

SECTION B INSTRUCTIONS

Please give option for each statement by putting across (X) in any of the columns representing your opinion: Agree (A), Strongly Agree (SA), Disagree (D) and Strongly Disagree (SD)

S/N	**ITEMS**	**A**	**SA**	**D**	SD
1	I like Biology just like other subjects.				
2	Biology topics are too difficult for me to understand				
3	Biology enables me to develop skills in observation				
4	Biology is too difficult for me to understand				
5	Biology concepts are too difficult to understand				
6	Only those who wish to become scientists should study Biology				
7	Lesson periods (time) for Biology should be increased				
8	Biology is an interesting subject to learn				
9	I prefer working in groups in the Biology class				
10	No matter what effort I put to Biology I find it difficult to understand				
11	I enjoy reading Biology textbooks				
12	Biology lessons are not enjoyable at all				
13	I do not like to carry out practical work in Biology				
14	I do not like Biology lesson because it lacks students' participation				
15	to draw I don't find it difficult biological specimens				

16	I look forward to Biology practical classes				
17	Encouragement by teacher makes students like Biology				
18	I hate Biology because the teacher does not teach well				
19	The Biology laboratory in my school has many displayed specimens.				
20	I prepare notes for myself from Biology textbooks when I visit the school library				

APPENDIX IIB

Marking Guide for Student Attitude Toward Biology (SATBS)

1. Positive
2. Negative
3. Positive
4. Negative
5. Positive
6. Negative
7. Positive
8. Negative
9. Positive
10. Negative
11. Positive
12. Negative
13. Positive
14. Negative
15. Positive
16. Negative
17. Positive
18. Negative
19. Positive
20. Negative

APPENDIX IIIA

BIOLOGY STUDENTS SCIENCE PROCESS SKILLS ACQUISITION SCALE(BSSPSAS)

Introduction ;The purpose of this questionnaire is to find out the level of SPS by students in solving problems.

Name of School: ……. Sex: Male( ) Female ( ) **Age: ( )**

Instruction: Please answer all questions

(1) Figure i showed the family pedigree of Mr. and Mrs.Gabriel.

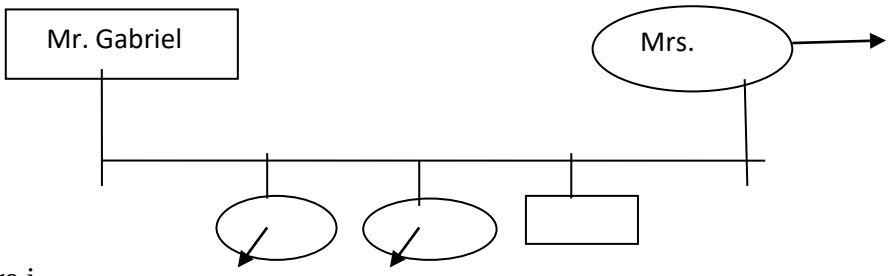


Figure i

Predict the number of grand children that Mr. and Mrs. Gabriel will have if their children should follow their mode in child bearing.

(2) Observe figure ii critically and write differences you observed from the two cows.

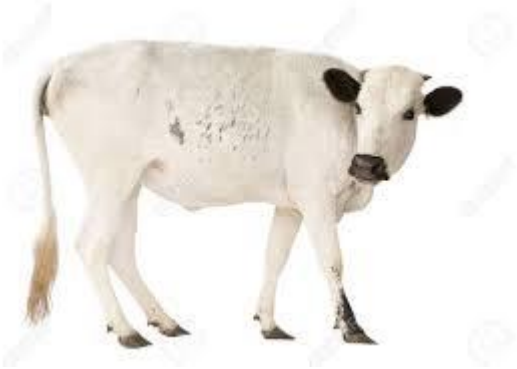


Figure ii

(3) One of the parents of Mrs. Daodu is albino. Mr. Daodu is light in complexion and Mrs. Daodu is dark in complexion. Two out of four of their children are suffering from albinism. Deduce reasons why two of their children are albino.

(4) Carry out the following activities with four members of your class that sat beside/behind you as it is slated in table i. (a) Ask him/her to demonstrate to you

whether he /she can roll their tongue (b) Check his/her ear whether is lobe or lobe-less.

Table i

S/N	Student's Identity	Tongue Rolling		Types of Ear		Height
		Ability to Roll	Inability to Roll	Lobe Ear	Lobeless Ear	
1	Myself					
2	1st Student					
3	2nd Student					
4	3rd Student					
5	4th Student					

(5) Use information from question 1- 5, to complete the table i

Table ii

S/N	Name of Items	Number of Items
1	Number of grand children question 1	
2	Number of differences between the two cows que.2	
3	Number of possible inferences question 3	
4	Number of lobe ear question 4	
5	Number of lobeless ear question 4	
6	Number of ability to roll tongue question 4	
7	Number of inability to roll tongue question 4	
8	Number of albino question 3	
9	Number of non- albino question 3	
10	Number of students involved in experiment in question 4	

(6) Use data from question 5 to draw a bar chart. Plot the name of items on x-axis and number of items on y-axis

APPENDIX IIIB

Marking Guide for Biology Students' Science Process Skills AcquisitionScale (BSSPSAS)

1. Nine (9)

2.

S/N	Black	White
1	Big	Small
2	Black in colour	White in colour
3	Horn is present	Horn is absent

3 (i). Hereditary (ii) The two of their children was albino because they inherit albinism fom the parent of their mother.

4. (i) No mark for students that tick ability roll tongue and inability to roll tongue at the same time (ii) No mark for students that tick lobe ear and lobless ear at the same time

5. Number of items must correspond with answer given ealier.

6.The scale of the graph must be clearly stated and clearly shown

APPENDIX IIIC

BIOLOGY STUDENTS SCIENCE PROCESS SKILLS RATING SCALE

(BSSPSRS)

Part A

School name……..

Class……... Age…… Sex; Male( ) Female ( )

Part B

Qut	Recoding		Observing			Inferring			Experimenting				Predicting										Graphing									
No	0	1	0	1	2	0	1	2	0	1	2	3	0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1																																	
2																																	
3																																	
4																																	
5																																	
6																																	

Question No	Scores
1	
2	
3	
4	
5	
6	
Total scores	

APPENDIX IVA

BIOLOGY STUDENTS' LEARNING STYLE SCALE (BSLSS)

Section A

Name:_____ School name _____ Sex M ( ) F( )

Section B

INSTRUCTION. Tick the letter of the phrase that is true for you most of the time.

S/N	ITEMS	A	B	C
1	In the course that I need to learn something, I learn best when I:	Endeavor to practice it without anybody's assistance	Observe someone doing it	Listened to somebody reveal to me how
2	At the point when I read, I regularly find that I	Recite for all to hear or hear myself in the course of resding	Envision what I am guessing what in me might be thinking's eye	Squirm and attempt to "feel" the substance
3	When requested to give headings, I	Need to pont or move my bodiy as I given them	See the genuine spots in my psyche as I say them or like to draw them	Have no trouble in giving them verbally
4	On the off chance that I am uncertain how to spell a word, I	Compose it to decide whether it feels right	Compose it to decide whether it looks right	Illuminate it noisy to decide whether it sounds right
5	At the point when I compose, I:	Push hard on my pen or pencil and feel the progression of the words or letters as I structure them	Am concerned how perfect and very much separated my letters and words show up	Frequently say the letters and words to myself
6	On the off chance that I needed to recollect a rundown of things, I would recall it best on the off chance that I	Moved around and utilized my fingers to name every thing	Kept in touch with them down	Said them again and again to myself
7	I incline toward educators who:	Utilize active exercises	Utilize the board or overhead projector while they address	Talk with a ton of articulation
8	When attempting to focus, I struggle	I need to stand by for any period of time	There is a ton of messiness or development in the	There is a ton of clamor in the room

	when When tackling an issue, I		Room	
9	When tackling an issue, I	Utilize my whole body or move object to help me think	Writei or draw dagrams to seen it	Talk myselfthrough it
10	On the off chance that I needed to verbally portray something to someone else, I would;	Attempt to assemble the parts first and read later	Peruse them quietly and attempt to picture how the parts will fit together	ecite them so anyone can hear and converse with myself as I set up the parts
11	To keep occupied while waiting, I:	Stroll around, control things with myhands,or move/shake myfeet as I sit	Glance around, gaze, or read	Talk or tune in to other people
12	On the off chance that somebody were verbally portraying something to me, I would;	Motion and move around while talking	Be brief since I don't prefer to talk finally	Really expound in light of the fact that I like to talk
13	If someone were verbally describing something to me, I would;	Become exhausted if her portrayal got excessively long and itemized	Attempt to envision what she was saying	Appreciate tuning in however need to hinder and talk myself
14	When attempting to review names, I recollect:	Thecircumstance that I met the individual other thanthe individual's nameor iface	Faces yet neglect name	Names, however neglect faces

APPENDIX IVB

MARKING GUIDE FOR BIOLOGY STUDENTS LEARNING STYLE SCALE (BSLSS)

Scoring Instructions: Add the number of responses for each letter and enter the total below. B for **Visual (V), C for Auditory (A) and A for Kinesthetic (K) .**

Visual (V) = _____

Auditory (A) = _____

Kinesthetic (K) = _____

The area with the highest number of responses is probably the primary mode of learning style for the students. Remember, most students learn through a mixture of all three styles.

APPENDIX VA

BIOLOGY STUDENTS' MENTAL ABILITY TEST (BSMAT)

INTRODUCTION

This test is designed to see how well and articulate you can think. Your responses will be kept confidential and used for research purpose only.

SECTION A

Please fill in the information about yourself as a form of a bio-data.

1. Name:_____ Sex: Male ( ) female ( )
2. School:_____ Age:_____

SECTION B

TIME: 1 HR

Discover the appropriate response that best finishes the relationship

1. Book is to perusing as fork is to… … ..
   [a] Drawing [b] writing [c] stirring [d] eating

2. As'Earthquake'is related to'Earth',similarly 'Thundering'is identified with what?
   (A)Earth (B)Sea (C)Fair (D)Sky

3. As 'Football' is identified with 'Field' similarly, 'Tennis' is identified with what?
   (A) Court (B) Net (C) Field (D) None of these

4. As 'Fly' is identified with Parrot' similarly 'Creep' is identified with what?
   (A) Snake (B) Rabbit (C) Fish (D) Crocodile
5. As 'Needle; is identified with 'String' similarly 'Pen' is identified with what?
   (A) Word (B) compose (C) Cap (D) Ink
6. Which number should come next in the pattern? 37, 34, 31, 28,
   [a] 30 [b] 34 [c] 25 [d] 21
7. What number best finishes the similarity 8:4 as 10:
   [a] 5 [b] 3 [c] 7 [d] 24

8. Which of the accompanying can be orchestrated into a 5-letter English word?

[a] HRGS [b] RILSA [c] TOOMT [d] WQRG

9. Track down the oddball

[a] apple [b] marmalade [c] cherry [d] grape

10. Which number does not belong?

	4 32	144	
	17	28	122
	18	64	188
	322	14	202

[a] 14 [b] 17 [c] 18 [d] 32

11. Find the odd one out

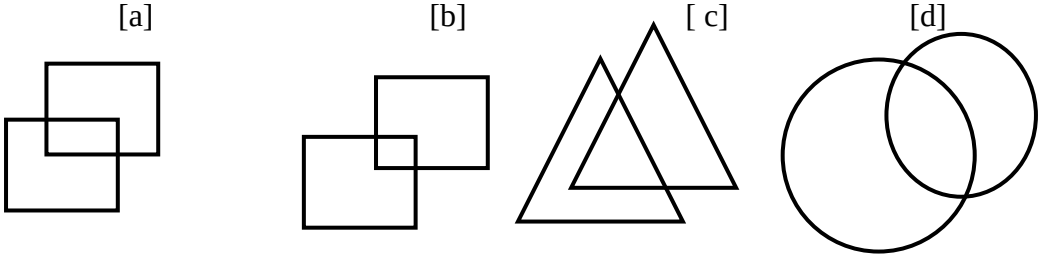
[a] Accelerate [b] Expedite [c] Hurry [d] Run

12. Find the odd one out

[a] Tomato [b] coffee [c] carrot [d] orange

13. Which is odd one out?

[a] [b] [c] [d]



14 Library isto book as book is

[a] Binding [b] copy [c] cover [d] page

15. Find the next number in the following series 1 3 6 10

[a] 4 [b] 8 [c] 15 [d] 19

16. A cake is to be cut into 10 equal pieces. How many cuts does the baker need to make? [a] 8 [b] 9 [c] 10 [d] 11

17. Which number comes next? 25, 24, 22, 19, 15

[a] 8 [b] 10 [c] 12 [d] 14

18. Which of the following are both spelled correctly?

[a] bsc, Phd [b] Bsc, PhD [c] BSc, PhD [d] BsC, phD

19. Which of the following does not belong? **Edit, bond, part, time**

[a] Edit [b] bond [c] time [d] part

20. Which of the following does not belong? December, March, June August

[a] December [b] March [c] June [d] August

21. Which of the following four numbers does not belong? **4, 7, 9, 12**

[a] 4 [b] 7 [c] 9 [d] 12

APPENDIX VB

MARKING GUIDE FOR BIOLOGY STUDENTS' MENTAL ABILITY TEST (BSMAT)

1. D
2. D
3. A
4. A
5. D
6. C
7. A
8. B
9. B
10. A
11. B
12. A
13. D
14. D
15. C
16. B
17. B
18. C
19. B
20. C
21. B

APPENDIX VI

LESSON PLANS FOR GALLERY WALKS STRATEGY

The following lesson plans was used for teaching the genetics concept using the Gallery Walks strategy of teaching

Lesson 1 (Gallery Walks Strategy)

Topic: Genetics

Duration: 1hr 20min

Reference: Ndu, F. O. C., Asun, P, and Aina (1999). Senior Secondary Biology 2. Ikeja, Longman Nigeria PLC 181pp. Umeh, I. G. Modern Biology

Instructional Materials: Genetic chart and video slide on genetic

Behavior objectives:

(i) Define the following terms: Genetic and Gene

(ii) Identify xx and xy chromosomes

(iii) Identify the structure that responsible for gene carrier

(iv) List some genetics terms.

(v) Mention number of pairs of chromosome in man

Entry Behavior: Students already familiar with the meaning of heredity.

Introduction: The teacher introduces the lesson to the students by stating that a genetics anchor gene, heredity and genetic variation

Presentation:

Step 1:- Create and post question. The teacher formulate questions on the term genetics

1. Define heredity, genetics and gene
2. Describe two major types of cell
3. List some genetics terms

3 Mention number of pairs of chromosome in man

Step 2: **- Group the student and assign roles**: - The students were grouped and collect their assigned roles.

Step 3: **- Assign stations and begin comments**: - The students choose their stations for their group and begin comments

Step 4: - **Rotation**: - After five to seven minute the students "rotate". The group them move from initial station to another. The group adds new comment and responds to note left by the previous group.

Step 5: - **Oral Presentation**: - In the course of visiting each station the learners got back to their unique station and takes five to ten minutes) to combines all remarks on the displayedpaper. The reporter makes an oral presentataion. During the show the facilitator supports significant idea and correct misconception and error.

Summary: The teacher summaries the lesson by mentioning that gene responsible for the transmission of character in man: Colour,height, shape etc.

Evaluation: Teacher asks the students the following questions;

(i) Define the following terms

(ii) Mention the sex chromosomes for male and female

Assignment: List 10 transmittable trait in man and six transmittable trait in plant.

Lesson 2 (Gallery Walks Strategy)

Topic: Transmission and Expression of characters from parent to offspring

Duration: 1hr 20min

Behavioural objective:

(i) Identify transmittable trait in man.

(ii) Identify transmittable trait in plant.

(iii) Mention seven transmittable trait in man

(iv) Mention four transmittable trait in plant.

Entry behavior: Students had already known that genetic anchored gene, heredity and genetic variation.

Introduction: The teacher introduce the lesson by telling the students that trait are the genetic materials that make man different from others.

Presentation:

Step 1: - Create and post question. The teacher formulate questions on the topic of the day

1. Identify transmittable traits in man
2. Identify transmittable traits in plant
3. List seven transmittable traits in man
4. List seven transmittable traits in plant

The teacher put a question in a station.

Step 2: **- Group the student and assign roles**: - The students were grouped and collect their assigned roles.

Step 3: **- Assign stations and begin comments**: - The students choose their stations for their group and begin comments

Step 4: **- Rotation**: - After five to seven minute the students "rotate". The group thenmove from originalposition to another. The group adds new comment and answersthe note left by the former group.

Step 5: **- Oral Presentation**: - After visiting each station the learner got back to their unique station and takes five to ten minutes to blends all remarks on the displayedpaper. The correspondent makes an oral presentation. In the course

of the presentation, the facilitator emphasizes important concept and correct misconception and error.

Summary: The teacher summaries the lesson by stating that the trait are nmaterials that makes us different from others.

Evaluation: Tutorasks the students the followingquestions.

(i) Mention three functions of chromosome.

(ii) Make a label diagram of chromosomes

Assignment: In detail, describe the structure and function of chromosome.

Lesson 3. (Gallery Walks Strategy)

Topic: Chromosome the basis of heredity

Duration: 1hr 2mins

Behavioural Objectives:

(i) Explain what you understand by word chromosome

(ii) Mention the functions of chromosomes

(iii) Draw the structure of chromosome.

(iv) What is the relationship between DNA and chromosomes

Entry Behaviour: Students already know how trait is being transfer to young ones.

Introduction: The teacherintroduces the lessonby telling the students that chromosomes are the carrier of gene in human. In addition, there is gene for almost every thing (gene for color, height, shape etc).

Presentation:

Step 1: - Create and post questions; The teacher formulates questions on the concept chromosome as basic of heredity.

1. Explain the term chromosome
2. List two functions of chromosome
3. Draw the structure of chromosome
4. What is the relationship between chromosome and DNA.

Step 2: **- Group the student and assign roles**: - The students were grouped and collect their assigned roles.

Step 3: **- Assign stations and begin comments**: - The students choose their stations for their group and begin comments

Step 4: **- Rotation**: - After five to seven minute, the students "alternate". The group then move from firstplace to another. The group writes new comment and reacts to note written by the formaer group.

Step 5: - **Oral Presentation**: - after visiting each station the learner got back to their unique station and takes five to ten minutes to blends all remarks on the displayedpaper. The correspondent presented what was written on the

displayed paper. In the process of presentation, the correspondent laid emphasy on major concept and correct misconception and error.

Summary: The teacher summaries the lesson by giving a very suitable explanation for chromosomes.

Evaluation: The teacher evaluates the students' group project work by asks the following questions.

(1) Mention two functions of chromosomes

(2) Explain relationship between chromosomes and DNA

Assignment: (i) State first mendelian law of segregation

Lesson 4 (Gallery Walks Strategy)

Topic: First Mendelian Law

Duration: 1hr 2mins

Behavioural Objectives:

(i) Describe the Gregor Mendels experiment

(ii) State first law of mendel.

(iii) Carry out simple genetic crossing (dihybrid crossing)

(iv) Write phonotypical and genotypical ratio

Entery Behaviour: Students are already been taught that chromosomes is basis of heredity

Introduction: The tutor introduces thelesson by telling the students that there is separation at parent level during gamete crossing.

Presentation

Step 1: - Create and post question: - The teacher formulate questions on the topic of the day.

1. State Mended first law
2. What happens if a red flower of dominant (RR) pea plant is cross with white flower recessive (rr) pea plant
3. Cross the heterozygous tall (Tt) plant parent with the homozygous tall (TT)
4. Draw punett square and write phenotypical and genotypical ratio of Crossing the heterozygous tall (Tt) plant parent with the homozygous tall (TT)

Step 2: **- Group the student and assign roles**: - The students were grouped and collect their assigned roles.

Step 3: **- Assign stations and begin comments**: - The students choose their stations for their group and begin comments

Step 4: **- Rotation**: - After five to seven minute the students “swap”. The group then move from firstposition to another. The group writes new comment and reacts to note written by the first group.

Step 5: - **Oral Presentation**: - after visiting each station the learner got back to their unique station and takes five to ten minutes to blends all remarks on the displayedpaper. The correspondent presented what was written on the displayed papaer. In the process of presentation, the correspondent laid emphasy on major concept and correct misconception and error..

Summary: Theteacher summarize the lessonby telling the students the important the important of gamete separation

Evaluation: the teacher ask the students the following questions

(i) State first law of Mendel

(ii) Cross tall maize of dominant T T with a short maize of recessive t t.
Write out the (a) Phenotypic ratio (b) Genotypic ratio

Assignment:

(i) State second law of mendel

Lesson 5 (Gallery Walks Strategy)

Topic: **Second mendel law.**

Duration: 1hr 20min

Behavioural objective:

(i) State second law of mendel

(ii) Carry out genetic crossing on second law of mendel at first filial generation

(iii) Write phonotypical and genotypical ratio

(iv) Prepare punnet square for second filial generation of mendel second law

Entery Behaviour: Students are already been taught the first law of mendel

Introduction: The tutor introduces thelesson by telling the learners that trait can be separate independently

Presentation

Step 1: - Create and post question: -The teacher formulate questions on the topic of the day.

1 State second law of mendel

2 Prepare punnet square of Crossing dominant tall recessive white rat with recessive short dominant black rat in the second filial generation

3 Complete the table bellow. B and b rep. colours i.e B-Brown(dominant) b-Yellow (recessive) and E and e rep. size i.e E-big(dominant) e-small(recessive). Write the offspring and its ratio.

Gametes		Female Gamete			
		BE	Be	bE	be
Male Gamete	BE				
	Be				
	bE				
	Be				

Step 2: - **Group the student and assign roles**: - The students were grouped and collect their assigned roles.

Step 3: - **Assign stations and begin comments**: - The students choose their stations for their group and begin comments.

Step 4: - **Rotation**: - After five to seven minute the students "swap". The group then move from firstposition to another. The group adds new comment and reacts to note written by the former group.

Step 5: - **Oral Presentation**: - after visiting each station the learner got back to their unique station and takes five to ten minutes) to blends all remarks on the posted sheet. The correspondent makes an oral presentation. In the process of presentation, the correspondent laid emphasy on major concept and correct misconception and error.

Summary: The teacher summaries the whole lesson by telling the students that trait need to be separate independently in order to allow gamete formation to take place.

Evaluation: The teacher asks the students the following questions

(i) State second law of mendel

(ii) Cross black dominant and short recessive cow with recessive white and dominant tall cow.

Assignment:(i) What is probability in genetic?

Lesson 6 (Gallery Walks Strategy)

Topic: **Probability in genetic**

Duration: 1hr 20min

Behavioural Objective:

(i) State product rule

(ii) Calculate the no offspring

(iii) Use punnett squares to determine the probability of inheriting trait

Entry Behavior: Students have already been taught how to use punnett square in genetic crossing.

Introduction: The tutor introduces the lessonby telling the students that punnett square is very important in genetic probability.

Presentation

Step 1: - Create and post questions- The teacher formulates questions on the topic of the day.

1. State product rule.
2. If red heterozygous plant is crossed with another red heterozygous plant. What is probability of having white flowering offspring?
3. From the punnet square. Find the probability of dominant tall, homozygous short and heterozygous tall

X	T	T
T	TT	Tt
T	Tt	Tt

Step 2: **- Group the student and assign roles**: - The students were grouped and collect their assigned roles.

Step 3: **- Assign stations and begin comments**: - The students choose their stations for their group and begin comments

Step 4: **- Rotation**: - After five to seven minute the students "swap". The group then move from originalposition to another. The group adds new comment and reacts to note written by the former group.

Step 5: - **Oral Presentation**: - after visiting each station the learner got back to their unique station and takes five to ten minutes to blends all remarks on the displayed paper. The correspondent presented what was written on the displayed paper. In the process of presentation, the correspondent laid emphasy on major concept and correct misconception and error.

Summary: The teacher summaries their lesson by mentioning that the relevance of probability in biology and important of probability in genetic.

Evaluation: The teacher ask the students to do class work :If red heterozygous plant is crossed with another red heterozygous plant. What is probability of having white flowering offspring.

Assignment: Write two importance's of genetic in agricultural science and medicine

Lesson 7 (Gallery Walks Strategy)

Topic: Application of the principle of heredity in agricultural science and medicine

Duration: 1hr 20min

Behavioural Objective:

(i) Identify the importance of genetic in agricultural science on

(a) plant breed (b) improved varieties (c) diseases resistance varieties

(a) drought resistance varieties

(ii) Identify the importance of genetice in medicine

(a) cross fertilization (b) self fertilization

Entry Behavior: The students have already been taught the probability in genetics

Introduction: The teacher introduces the lesson by telling the students that advance in the field of genetics is the bed rock of science and technology in the world.

Presentation

Step 1: - Create and post question: - The teacher formulate questions on the application of genetics in agricultural science and medicine

1.Mention three area that scientists has introduce improvement to the field of agricultural science

2.Mention three area that scientists has introduce improvement to the field of medicine.

Step 2: **- Group the student and assign roles**: - The students were grouped and collect their assigned roles.

Step 3: **- Assign stations and begin comments**: - The students choose their stations for their group and begin comments

Step 4: **- Rotation**: - After five to seven minute the students“swap”. The group thenmove from their formal pointto another. The group adds new comment and reacts to note written by the former group.

Step 5: - **Oral Presentation**: - after visiting each station the learner got back to their unique station and takes five to ten minutes to blends all remarks on the displayed sheet. The correspondent presented what was written on the displayed sheet. In the process of presentation, the correspondent laid emphasy on major concept and correct misconception and error.

Summary: The tutor summaries the lesson by telling the learners the advantages of application of genetics in the field of agricultural science and medicine

Evaluation: The teacher asks the students the following questions

(i) List two advantages of application of genetics in agricultural science

(ii) List two advantages of application of genetics in the field of medicine

Lesson 8 (Gallery Walks Strategy)

Topic: **Revision**

Duration: 1hr 20min

Behavioural Objectives:

(i) Define genetics and heredity

(ii) List genetics terminologies

(iii) State first and second Mendel laws

(iv) Perform genetics crossing and genetics probability

Entry Behaviour: The students have already been taught the various aspect of genetics

Introduction: The teacher introduces the lesson by mind mapping various aspect of genetics that students have been taught.

Presentation

Step 1: - Create and post question; The teacher formulate the questions on genetics

1 Define genetics and heredity
2 List eight genetics terminologies
3 State first and second Mendel laws
4 Perform genetics crossing and genetics probability

Step 2: **- Group the student and assign roles**: - The students were grouped and collect their assigned roles.

Step 3: **- Assign stations and begin comments**: - The students choose their stations for their group and begin comments

Step 4: **- Rotation**: - After five to seven minute the students "swap". The group then move from firstlocation to another. The group adds new comment and reacts to note written by the former group.

Step 5: - **Oral Presentation**: - after visiting each station the learner got back to their unique station and takes 5-10 minutes to blends the remarks on the displayedpaper. The correspondent presented what was written on the displayed paper. In the process of presentation, the correspondent laid emphasy on major concept and correct misconception and error.

Summary: Theteacher summaries the lessonby telling the students the important of mind mapping .

Evaluation: The teacher evaluates his/her teaching by asks the following question from students.

(i) Define gene and heredity

(ii) List five genetics terms

(iii) Mind mapping the application of genetics .

APPENDIX VII

LESSON PLANS FOR MIND MAPPING STRATEGY

The following lesson plans will be used for teaching genetics concepts using Mind Mapping strategy of teaching.

Lesson 1 (Genetics)

Topic: Genetics

Duration: 1hr 20min

Instructional Materials: Genetic chart and video slide on genetic

Behavior objectives:

(i)Define the following terms: Genetic and Gene

(ii)Identify xx and xy chromosomes

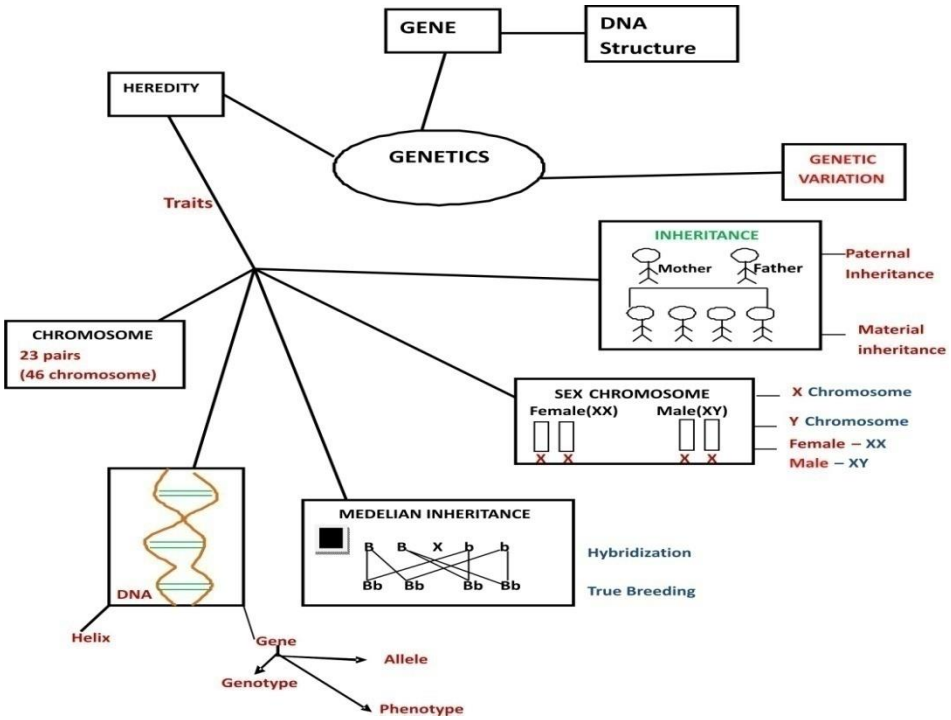
(iii)Identify the structure that responsible for gene carrier

(iv)List some genetic terms.

1 Mention number of pairs of chromosome in man

Entry Behavior: Students already familiar with the meaning of heredity.

Introduction: The teacher introduces the lesson to the students by stating that a genetic anchor gene, heredity and genetic variation.



Presentation

Summary: The teacher summaries the lesson by mentioning that gene responsible for the transmission of character in man :Colour,height, shape etc.

Evaluation: theteacher asks the students the following questions;

(i)Define the following terms

(ii)Mention the sex chromosomes for male and female

Assignment: List 10 transmittable trait in man and six transmittable traits in plant.

Lesson 2 (Mind Mapping Strategy)

Topic: **Transmission and Expression of characters from parent to offspring**

Duration: 1hr 20min

Behavioural objective:

(i)Identify transmittable trait in man.

(ii)Identify transmittable trait in plant.

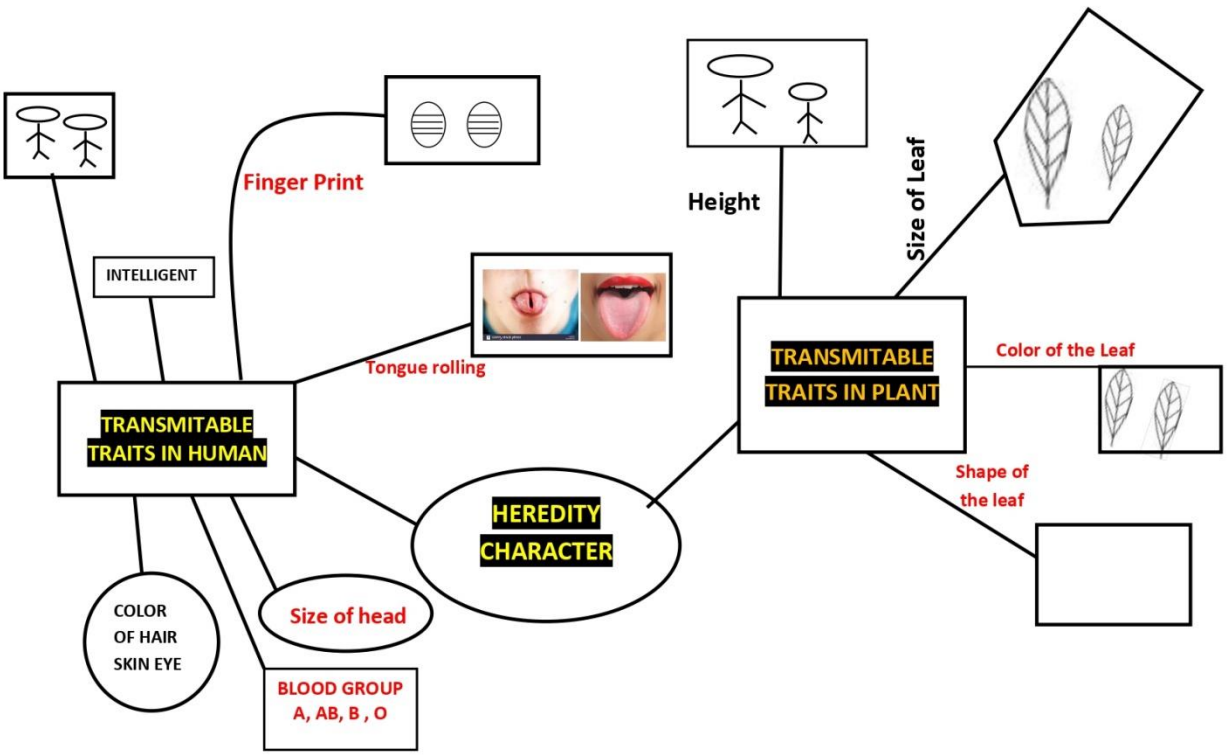
(iii)Mention seven transmittable trait in man

(iv)Mention four transmittable trait in plant.

Entry behavior: Students had already known that genetics anchored gene, heredity and genetic variation.

Introduction: The tutor introduce the lesson by telling the learners that trait are the genetic materials that make man different from others.

Presentation



Summary: The teacher summaries the lesson by stating that the trait are nmaterials that makes us different from others.

Evaluation: Theteacher asks the students the followingquestions.

(i)List four transmittable characters in man.

(ii)List four transmittable characters in plant.

Assignment: In detail, describe the structure and function of chromosome.

Lesson 3 (Mind Mapping Strategy)

Topic: Chromosome the basis of heredity

Duration: 1hr 2mins

Behavioural Objectives:

(i)Explain what you understand by word chromosome

(ii)Mention the functions of chromosomes

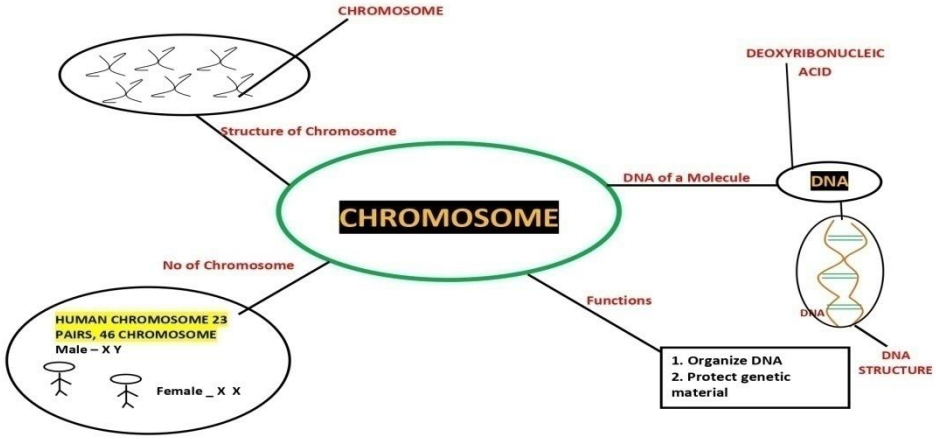
(iii)Draw the structure of chromosome.

(iv)What is the relationship between DNA and chromosomes

Entry Behaviour: Students already know how trait is being transfer to young ones.

Introduction: Theteacher introduces thelesson by telling the students that chromosomes are the carrier of gene in human. In addition, there is gene for almost every thing (gene for color, height, shape etc).

Presentation



Summary: The teacher summaries the lesson by giving a very suitable explanation for chromosomes.

Evaluation: The teacher evaluates the students' group project work by asks the following questions.

(i)Mention two functions of chromosomes

(ii)Explain relationship between chromosomes and DNA

Assignment: (i) State first mendelian law of segregation

Lesson 4 (Mind Mapping Strategy)

Topic: **First Mendelian Law**

Duration: **1hr 2mins**

Behavioural Objectives:

(i)Describe the Gregor Mendels experiment

(ii)State first law of mendel.

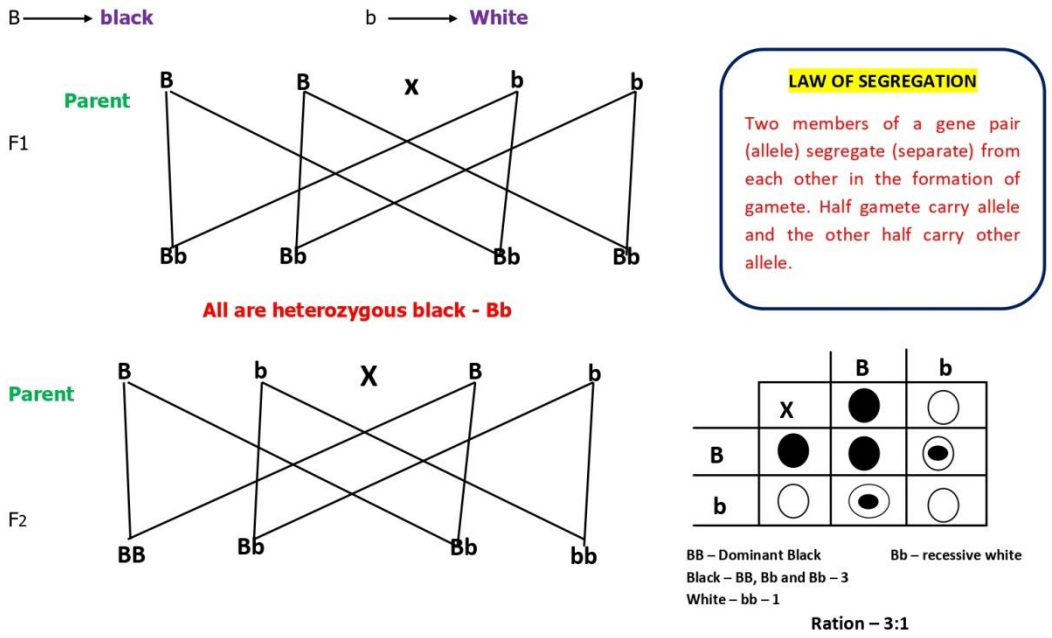
(iii)Carry out simple genetic crossing (dihybrid crossing)

(iv)Write phonotypical and genotypical ratio

Entery Behaviour: Students are already been taught that chromosomes is basis of heredity

Introduction: The tutor introduces the lesson bytelling the learners that there is separation at parent level during gamete crossing.

Presentations



Summary: The tutorr summarize the lessonby telling the learners the important the important of gamete separation

Evaluation: the teacher ask the students the following questions

(i)State first law of Mendel

(ii)Cross tall maize of dominant T T with a short maize of recessive t t.

Write out the (a) Phenotypic ratio (b) Genotypic ratio

Assignment:

(ii) State second law of mendel

Lesson 5 (Mind Mapping Strategy)

Topic: **Second mendel law.**

Duration: 1hr 20min

Behavioural objective:

(i)State second law of mendel

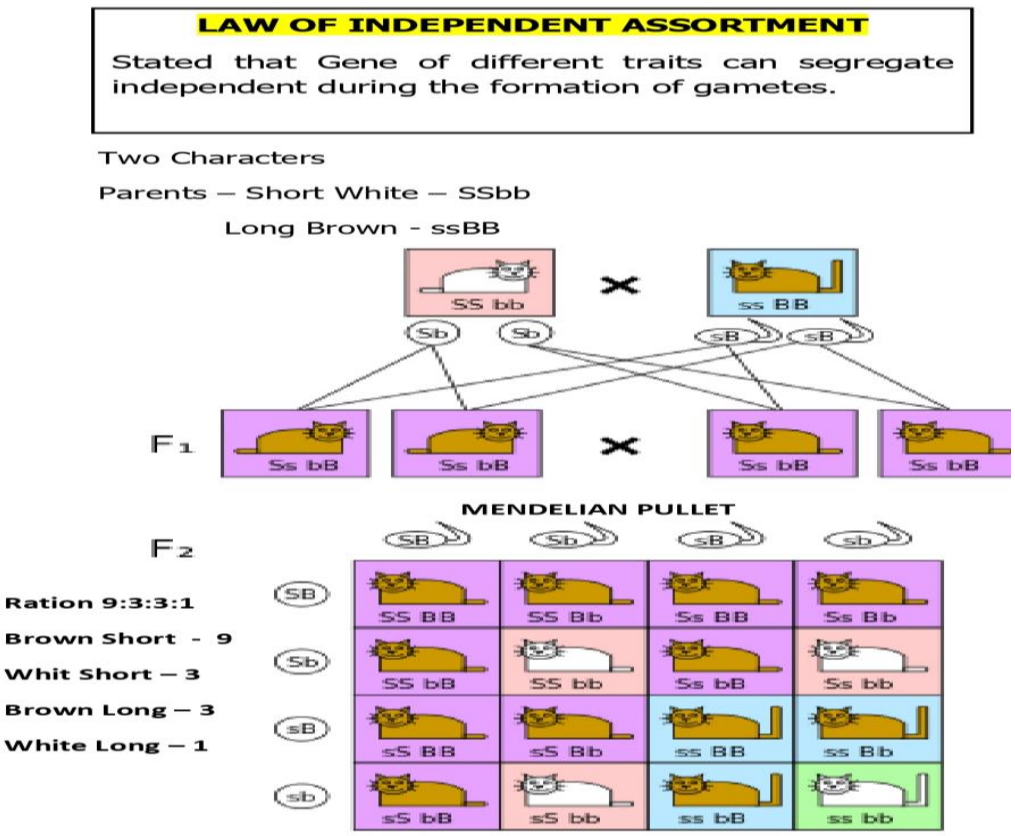
(ii)Carry out genetic crossing

(iii)Write phonotypical and genotypical ratio

Entery Behaviour: Students are already been taugh the first law of mendel

Introduction: The tutor introduces thelesson by telling the learners that trait can be separate independently

Presentation



Summary: The teacher summaries the whole lesson by telling the students that trait need to be separate independently in order to allow gamete formation to take place.

Evaluation: The teacher asks the students the following questions

(i)State second law of mendel

(ii)Cross black dominant and short recessive cow with recessive white and dominant tall cow.

Assignment:(i) What is probability in genetic?

Lesson 6 (Mind Mapping Strategy)

Topic: **Probability in genetics**

Duration: 1hr 20min

Behavioural Objective:

(i)State product rule

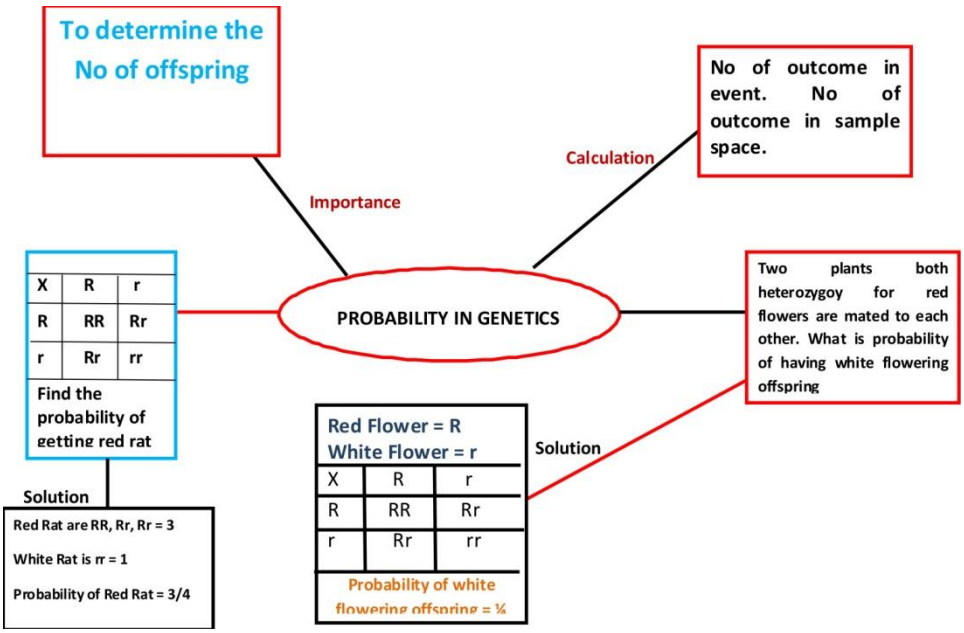
(ii)Calculate the no offspring

(iii)Use punnett squares to determine the probability of inheriting trait

Entry Behavior: Students have already been taught how to use punnett square in genetic crossing.

Introduction: The tutor introducesthe lesson by telling the learners that punnett square is very important in genetic probability.

Presentation



Summary: The teacher summaries their lesson by mentioning that the relevance of probability in biology and important of probability in genetic.

Evaluation: The teacher ask the students to do class work: what is the probability that a white flower will be obtained If red heterozygous plant is crossed with another red heterozygous plant.

Assignment: Write two importance's of genetic in agricultural science and medicine.

Lesson 7 (Mind Mapping Strategy)

Topic: Application of the principle of heredity in agricultural science and medicine

Duration: 1hr 20min

Behavioural Objective:

(i)Identify the importance of genetic in agricultural science on

(a)plant breed (b) improved varieties (c) diseases resistance varieties

(d) drought resistance varieties

(ii)Identify the importance of genetice in medicine

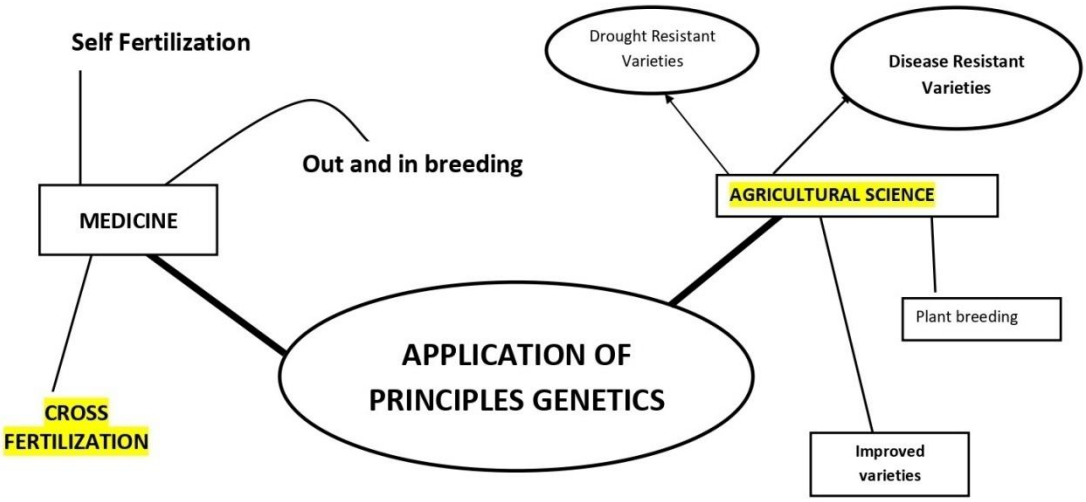
(a)cross fertilization (b) self fertilization

(iii)List and explain the factors that causes evolution

Entry Behaviour: The students have already been taught the probability in genetics

Introduction: Theteacher introducesthe lesson by telling the students that advance in the field of genetics is the bed rock of science and technology in the world.

Presentation



Summary: The teacher summaries the lesson by telling the students the advantages of application of genetics in the field of agricultural science and medicine

Evaluation: The teacher asks the students the following questions

(i)List two advantages of application of genetics in agricultural science

(ii)List two advantages of application of genetics in the field of medicine

Lesson 8 (Mind Mapping Strategy)

Topic: **Revision**

Duration: 1hr 20min

Behavioural Objectives:

(I) Define genetics and heredity

(II) List genetics terminologies

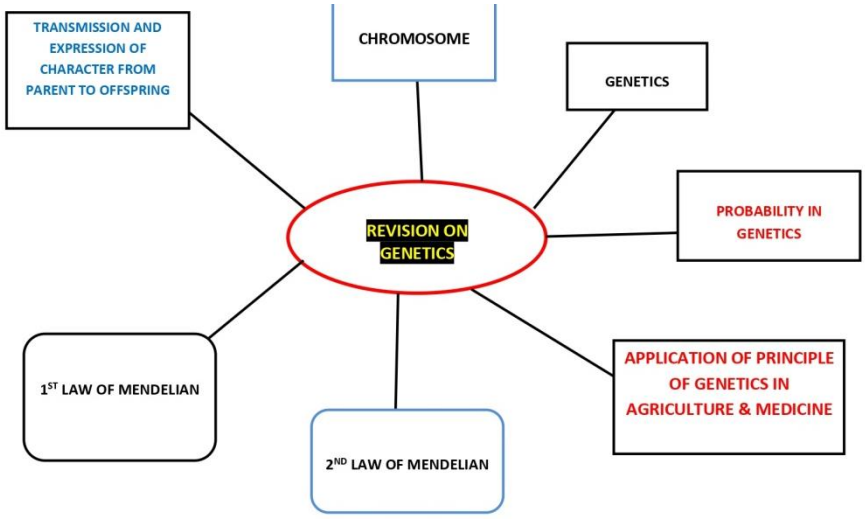
(III)State first and second Mendel laws

(IV)Perform genetics crossing and genetics probability

Entry Behaviour: The students have already been taught the various aspect of genetics

Introduction: The teacher introduces the lesson by mind mapping various aspect of genetics that students have been taught.

Presentation



Summary: Theteacher summaries the lessonby telling the studnts the important of mind mapping .

Evaluation: The teacher evaluates his/her teaching by asks the following question from students.

(i)Define gene and heredity

(ii)List five genetics terms

(iii)Mind mapping the application of genetics .

APPENDIX VIII

LESSON PLANS FOR CONVENTIONAL STRATEGY

The following lesson plans will be used for teaching the genetics concepts in biology using lecture method.

Lesson 1(Conventional Strategy)

Topic: Genetics

Duration: 1hr 20min

Instructional Materials: Genetic chart and video slide on genetic

Behavior objectives:

(I)Define the following terms: Genetic and Gene

(II)Identify xx and xy chromosomes

(III)Identify the structure that responsible for gene carrier

(IV)List some genetic terms.

(V)Mention number of pairs of chromosome in man

Entry Behavior: Students' already familiarwith the meaning of heredity.

Introduction: The tutor introduces the lesson to the students by stating that a genetic anchor gene, heredity and genetic variation.

Presentation:

Step 1: The teacher defines "genetics ",

Step 2: The teacher writes the sex cell for male and female for the students.

Step 3: The tutor list some genetics terms.

Step 4: The tutor mention the name of structure that responsible for carrier of gene.

Step 5: The teacher mention the numbers of chromosomes that man possesses

Summary: The teacher summaries the lesson by mentioning that gene responsible for the transmission of character in man :Colour,height, shape etc.

Evaluation: Teacherasks the students the followingquestions;

(I)Define the following terms

(II)Mention the sex chromosomes for male and female

Assignment: List 10 transmittable trait in man and six transmittable trait in plant.

Lesson 2 (Conventional Strategy)

Topic: **Transmission and Expression of characters from parent to offspring**

Duration: 1hr 20min

Behavioural objective:

(1) Identify transmittable trait in man.

(II)Identify transmittable trait in plant.

(III) Mention seven transmittable trait in man

(IV)Mention four transmittable traits in plant.

Entry behavior: Students had already known that genetic anchored gene, heredity and genetic variation.

Introduction: The tutor introduce the lessonby telling the learners that trait are the genetics materials that make man different from others.

Presentation:

The teacher put a question in a station.

Step 1: The teacher define and explain heredity

Step 2: The teacher Identify transmittable traits in man

Step 3: The teacher Identify transmittable traits in plant

Step 4: The teacher List seven transmittable traits in man

Step 5: The teacher List seven transmittable traits in plant.

Summary: The teacher summaries the lesson by stating that the trait are nmaterials that makes us different from others.

Evaluation: Teacherasks the students the followng questions.

(i)List four transmittable characters in man.

(ii)List four transmittable characters in plant.

Assignment: In detail, describe the structure and function of chromosome.

Lesson 3 (conventional Strategy)

Topic: Chromosome the basis of heredity

Duration: 1hr 2mins

Behavioural Objectives:

(I)Explain what you understand by word chromosome

(II)Mention the functions of chromosomes

(III)Draw the structure of chromosome.

(IV)What is the relationship between DNA and chromosomes

Entry Behaviour: Students already know how trait is being transfer to young ones.

Introduction: Theteacher introducesthe lesson by telling the students that chromosomes are the carrier of gene in human. In addition, there is gene for almost every thing (gene for color, height, shape etc).

Presentation

Step I: The teacher Explain the term chromosome

Step II: The teacher List functions of chromosome

Step III: The teacher Draw the structure of chromosome

Step IV: The teacher What is the relationship between chromosome and DNA.

Summary: The teacher summaries the lesson by giving a very suitable explanation for chromosomes.

Evaluation: The teacher evaluates the students' group project work by asks the following questions.

(I)Mention two functions of chromosomes

(I)Explain relationship between chromosomes and DNA

Assignment: (i) State first mendelian law of segregation

Lesson 4 (Conventional Strategy)

Topic: **First Mendelian Law**

Duration: **1hr 2mins**

Behavioural Objectives:

(I)Describe the Gregor Mendels experiment

(II)State first law of mendel.

(III)Carry out simple genetic crossing (dihybrid crossing)

(IV)Write phonotypical and genotypical ratio

Entery Behaviour: Students are already been taught that chromosomes is basis of heredity

Introduction: The tutorr introduces thelesson by telling the learners that there is separation at parent level during gamete crossing.

Presentation

Presentation

Step I: The teacher explain the Gregor Mendel's experiments

Step II: The teacher state Mended first law

Step III: The teacher writes question on genetic crossing; What happens if a red flower of dominant (RR) pea plant is cross with white flower recessive (rr) pea plant

Step IV: The teacher Draw punett square and write phenotypical and genotypical ratio of Crossing the heterozygous tall (Tt) plant parent with the homozygous tall (TT)

Summary: The teacher summarize the lesson by telling the students the important the important of gamete separation

Evaluation: the teacher ask the students the following questions

(I)State first law of Mendel

(I)Cross tall maize of dominant T T with a short maize of recessive t t.

Write out the (a) Phenotypic ratio (b) Genotypic ratio

Assignment:

(i)State second law of mendel

Lesson 5 (Conventional Strategy)

Topic: **Second mendel law.**

Duration: 1hr 20min

Behavioural objective:

(i)State second law of mendel

(ii)Carry out genetic crossing on second law of mendel at first filial generation

(iii)Write phonotypical and genotypical ratio

(iv)Prepare punnet square for second filial generation of mendel second law

Entery Behaviour: Students are already been taught the first law of mendel

Introduction: The tutorr introduces thelesson by telling the studentsthat trait can be separate independently.

Presentation

Step I: The teacher State second law of mendel

Step II The teacher Cross dominant tall recessive white rat with recessive short dominant black rat Cross dominant tall recessive white rat with recessive short dominant black rat in the second filial generation

Step III: The teacher Prepare punnet square of Crossing dominant tall recessive white rat with recessive short dominant black rat in the second filial generation.

Step IV: The teacher writes phonotypical and genotypic ratio for step II and III

Summary: The teacher summaries the whole lesson by telling the students that trait need to be separate independently in order to allow gamete formation to take place.

Evaluation: The teacher asks the students the following questions

(I)State second law of mendel

(II)Cross black dominant and short recessive cow with recessive white and dominant tall cow.

Assignment:(i) What is probability in genetics?

Lesson 6 (Conventional Strategy)

Topic: Probability in genetic **Duration:** 1hr 20min

Behavioural Objective:

State product rule

(II) Calculate the no offspring

(III) Use punnett squares to determine the probability of inheriting trait

Entry Behavior: Students have already been taught how to use punnett square in genetic crossing.

Introduction: The teacher introduces the lesson by telling the students that punnett square is very important in genetic probability.

Presentation

Step I: The teacher state product rule

Step II: The teacher write probability on the chalk board. Two plants both heterozygous

for red flowers are mated to each other. What is probability of having white flowering offspring?

Step III: The teacher draw a punnett square

Step IV: The teacher calculate the probability of dominant tall, homozygous short and

heterozygous tall from punnett square in step III

Step V: The teacher write note on the chalkboard.

Summary: The teacher summaries their lesson by mentioning that the relevance of probability in biology and important of probability in genetic.

Evaluation: The teacher ask the students to do class work : Two plants both heterozygous for red flowers are mated to each other .What is the probability having red flowering offspring .

Assignment: Write two importance's of genetic in agricultural science and medicine.

Lesson 7 (Conventional Strategy)

Topic: **Application of the principle of heredity in agricultural science and medicine**

Duration: 1hr 20min

Behavioural Objective:

Identify the importance of genetic in agricultural science on

(b) plant breed (b) improved varieties (c) diseases resistance varieties

(c) drought resistance varieties

(I) Identify the importance of genetice in medicine

(a) cross fertilization (b) self fertilization

(II) List and explain the factors that causes evolution

Entry Behaviour: The students have already been taught the probability in genetics

Introduction: Theteacher intrduces the lessonby telling the studnts that advance in the field of genetics is the bed rock of science and technology in the world.

Presentation

Step I: The teacher Mention three area that scientists has introduce improvement to the field of agricultural science

Step II: The teacher Mention three area that scientists has introduce improvement to the field of medicine.

Step III: The teacher Mention four improved varieties of maize

Step IV: The teacher writes note on the chalkboard.

Summary: The teacher summaries the lesson by telling the students the advantages of application of genetics in the field of agricultural science and medicine

Evaluation: The teacher asks the students the following questions

(iii) List two advantages of application of genetics in agricultural science

(iv) List two advantages of application of genetics in the field of medicine

Lesson 8 (Conventional Strategy)

Topic: **Revision**

Duration: 1hr 20min

Behavioural Objectives:

(I) Define genetics and heredity

(II) List genetics terminologies

(III)State first and second Mendel laws

(IV)Perform genetics crossing and genetics probability

Entry Behaviour: The students have already been taught the various aspect of genetics

Introduction: The teacher introduces the lesson by mind mapping various aspect of genetics that students have been taught.

Presentation

Step 1: The teacher Define genetics and heredity.

Step II: The teacher List eight genetics terminologies

Step III: The teacher State first and second Mendel laws

Step IV: The teacher sketch the evolutionary trend in invertebrate

Step V: The teacher Perform genetics crossing and genetics probability .

Summary: The tutor summaries the lessonby telling the learners the important of mind mapping .

Evaluation: The teacher evaluates his/her teaching by asks the following question from students.

(iv) Define gene and heredity

(v) List five genetics terms

(vi) Mind mapping the application of genetics.

APPENDIX IX

SCHEME OF WORK FOR GENETICS (SS2)

Week 1: Meaning of Genetics.

Week 2: Transmission and Expression of characters from parent to offspring.

Week 3: First Mendelian law.

Week 4: Second Mendelian law.

Week 5: Chromosomesthe basis of heredity.

Week 6: Probability in genetics.

Week 7: Application of the principle of heredityin agricultural science and medicine.

Week 8: Revision on genetic concepts.

APPENDIX X

ASSESSMENT SHEET FOR EVALUATING TEACHERS PERFORMANCE ON THE USE OF GALLERY WALKS STRATEGY (ASETPGWS)

Section A

Name of the teacher ……..Name of the school:…….

Topic taught:……Subtopic:……

Class taught:……Date:……..……

Section B

S/N	Performance assessed	V. Gooid 5	Goodi 4	Averge 3	Pooir 2	V. pooir 1
1.	**Create and Post Questions.** • How well does teacher create questions on the concept of the day • How appropriately does teacher post the questions into the different gallery stations					
2.	**Students Grouped and assigned Role to themeselves .** How well does students grouped and assigned role to themselves ?					
3.	**Group Select their Station and Begin Comments.** What strategy does student's use to select station for their group. How appropriately is the students comments on the concept of the day.					
4	**Rotation** How well does students rotate. How orderly is the student's rotation to another station?					
5	**Oral Presentation** How effectively and logically does students present their oral presentation.					

APPENDIX XI

ASSESSMENT SHEET FOR EVALUATING TUTORSPERFORMANCE ON THEUSE OF MIND MAPPING STRATEGY (ASETPMMS)

Section A

Name of the tutor ……Name of the school:……

Topic taught:……Subtopic:……..

Class taught:…… Date:……

Section B

S/N	Performance assessed	V. Good 5	Gooi d 4	Averge 3	Poor 2	V. poor1
1.	**Create a Central Idea** • How well does the teacher instruct the student on how to create central idea on the concept of the day.					
2.	**Add Branches to the map** • How well does student's add branches to their maps? • What is the level of students ability to construct /adds good branches to their map					
3.	**Add Key Words** • How well does student's add important words to their maps? • What is the level of students ability to formulate key words ?					
4	**Color Code** • How well does the students color code their map? • What is the level of student's ability to color code their map appropriately?					
5	**Include Image** • How well does students includes images to their map •					

APPENDIX XII

ASSESSMENT SHEET FOR EVALUATING TEACHERS PERFORMANCE

ON THE USE OFCONVENTIONAL STRATEGY (ASETPCS)

Section A

Nameof the teacher ……..

Name of the school:……

Topic taught:……

Class taught:……

Section B

S/N	Performance assessed	V. Good 5	Good4	Averge 3	Poor2	V. poor1
1	**Introduction** How well does the teacher introduce his lesson					
2	**Presentation:** How systemic is the presentation Does the teacher show mastery of subject matter					
3	**Summary** How concise as the summary					
4	**Evaluation** (Is it appropriate)					
5	**Assignment**					