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Evaluating the effectiveness of Practical-Based Instruction on Secondary School Students' Academic Achievement and Retention in Genetics in Ekiti, Nigeria

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Abstract

The research was on the effect of practical-based instruction on senior secondary students' achievement and retention in genetics in Ekiti, Nigeria. The moderating effect of gender was also examined. The study adopted the pretest, posttest, control group, quasi-experimental research design. The instrument used for data collection was Genetics Achievement Test (GAT) with the reliability value of 0.82 using Pearson Product Moment Coefficient. The target population of this study was 1356 which was the population of SSII Biology students in the study area. A sample of 292 students comprising 158 boys and 134 girls drawn from 6 schools in the Local government area selected using multi-stage sampling Procedures. Three research questions and four null hypotheses guided the study. The hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The study revealed that students taught genetics using practical-based instruction had significantly higher mean achievement scores and retention than those taught using conventional method F=555.374, P(0.0001<0.05) and F=117.523, P(0.0001<0.05) respectively. There was no significant difference between the mean achievement scores of male and female students taught genetics using practical-based instruction. Based on the findings, it was recommended among others that teacher's trainee should be trained on the use of practical-based instruction and serving teachers should use it. The teaching method is not gender sensitive therefore both male and female students should be involved in practical-based instruction to enhance their achievement and retention in genetics.

Keywords: Academic Achievements, Genetics, Practical based Instruction, Retention

Introduction

These days, science and technology rule the planet, where people face challenges that have their origins in science. Technology and science are now essential components of social and economic advancement. Nature has been effectively utilised and transformed into valuable resources for a better future thanks to science. Man can now live comfortably in society due to the amazing new developments in science education (Bush, 2020). Science education and cognitive scientists' basic research focusses on how individuals acquire science and use that information in their everyday lives. Scientific inquiry is the main method by which scientific knowledge is acquired as science disciplines.

One definition of science is the study of natural phenomena. Additionally, science is an impartial, rational, and credible endeavour to comprehend the principles and forces at work in the natural world. Aniodoh (2018), viewed science as a body of knowledge arrived at through systematic and procedural processes based on tentative observation and experiment. Science can be seen as both a process

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and a product, as a style of thinking in the quest to comprehend nature, a method of inquiry, and a body of established knowledge. Ambuonu, Opuli and Eze (2015), noted that without science the world today wouldn't have been what it is. The world has become a global village due to technological advancements in architecture, agriculture, and communication, among other areas.

Biology is a natural science that deals with the living world: how the world is structured, how it functions and what these functions are, how it develops, how living things came into existence, and how they react to one another and with their environment (Umar, 2017). It is an essential subject for many academic disciplines and makes a significant contribution to the country's technological advancement. This includes medicines, pharmacy, nursing, agriculture, forestry, biotechnology, nanotechnology, and many other areas (Ahmed & Abimbola, 2021).

Yang & Li (2018) declared that only a few of secondary school leavers pass SSCE biology at credit level. Therefore, the main goal of teaching biology in schools is to make sure that students have scientific knowledge that will enable them to pursue natural science education at any level. In order to attain skills, the content and concepts should be well understood.

According to Kampen (2024), one of the best traits a teacher may possess is the desire to include novel teaching techniques into their lesson plans. According to educational scholar Naga Subramani's book on Effective Teaching and Learning, a good teacher "constantly renews himself [or herself] as a professional on his [or her] quest to provide students with the highest quality of education possible." This teacher is not scared to use cutting-edge technology in the classroom or learn new teaching strategies. Some of such strategies include; think pair, peer instruction flip classroom, practical based instruction, and multimedia instructional strategies among others. This study focuses on the practical based instruction. According to Olorunyomi (2013), the majority of educators rigidly follow the 'chalk and talk method of instruction, which solely draws students' attention on the teacher's exhibited activity. As a result, teachers may not be exposing their students to meaningful learning, which has caused students to view certain courses as abstract and extremely challenging to comprehend. Additionally, this has resulted in students not performing to expectations.

Given the importance of biology, it would be necessary for biology instructors to learn suitable techniques that would enable them to comprehend concepts and principles for successful learning outcomes, particularly in genetics. According to Bateson & Mendel, (2013) Genetics is the study of heredity and how traits are passed from parents to offspring through genes, which are made of DNA. This field explains how characteristics like eye color, height, and susceptibility to certain diseases are inherited, and it also examines the variation in these traits among individuals and populations.

According to Akuma and Callaghan (2019), practical-based activities are a teaching strategy in which students actively participate in class activities using their hands and minds while being guided by the teacher. According to the author, these exercises allow students to demonstrate their proficiency with materials and practical tasks by utilising their hands or other mechanical skills. Students have immediate access to things for research, as demonstrated by practical based by inference. Material-centered activities, manipulative activities, and practical activities are other names for practical-based activities (Reeds & Shah, 2007; Tile, 2013). It is thought that

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teaching and learning methods that incorporate hands-on activities aid students in comprehending complex or abstract theories and concepts.

According to Moore (2019), academic achievement is the degree to which a student has fulfilled their immediate or long-term learning objectives; this is usually determined by grades, test scores, or degree completion. It can be seen as a gauge of performance on tests as well as a more general sign of learning and growth since it reflects the knowledge, abilities, and results acquired through instruction in a learning environment. According to Adepoju (2012), retention is the degree to which a person can recall previously learnt information at any particular moment. The author goes on to say that achievement and retention are measured together. This implies that retention determines achievement. According to Age & Machaba (2024), retention is the capacity to recall events and lessons learnt. Retention, according to the experts, involves mental preservation. These imply that the amount of knowledge gained and retained, the abilities retained, or the activities taken to solve problems consistently reflect what is retained. By definition, retention refers to a learner's ability to remember, retain, and repeat the knowledge they have acquired or at least part of it after a predetermined period of time.

Therefore, raising students' genetics accomplishment levels also means raising their retention of the genetics concepts they have acquired. Mir, Fatima & Fatima, (2023) reports that anything that aids learning should improve retention while things that lead to confusion or interference among learned material decrease the speed and efficiencyof learning and accelerates forgetting. Therefore, the researcher recognises the necessity to determine whether practical-based training could increase both male and female students' recall in genetics. Every element of human endeavour, including student performance, is impacted by gender differences, and research on the relationship between gender and science has remained unsolved.

Some studies, such as Falode (2014) and Yisa (2014), found no discernible gender difference in students' academic performance in scientific courses. Others found that science achievement is gender biassed. For instance, Ezeliora (2014) found that female students outperformed male students, whereas Iwende (2007) and Ifamuyiwa (2014) found that male students outperformed female students. In order to address the problem of secondary school students' poor performance in biology education, particularly on concepts related to genetics, the current researchers developed, validated, and evaluated the impact of practical based instruction on senior secondary school students' academic performance in biology on the concept of genetics. The study also looked at the possibility of gender bias in students' academic performance when practical-based training is used. However, there is a dearth of research on them, especially in the Nigerian setting. In light of this, the purpose of this study is to investigate how practical-based education affects secondary biology students' performance and retention in genetics in Ekiti, Nigeria.

Theoretical Framework

Among the theories covered are theory of learning by doing or experience and Bruner's (1960) theory of learning by discovery.

Bruner's (1960) Theory of Learning by Discovery

The significance of the discovery learning approach to instruction is emphasised by Bruner's notion of discovery learning.

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He believes that when a person is able to make their own judgements, learning is best promoted. This can be achieved in two ways: either the new learning material is incompatible with the existing knowledge structure or a restructuring is necessary to make room for it, or his cognitive structure that is, his existing knowledge structure is already adjusted to take in new information, in which case there is familiarity and the new set is simply assimilated.

This theory implies that when teaching science, teachers should design activities that will help students understand the fundamentals while they are engaged in the activity. Students use their newly developed cognitive skills to solve a problem in a discovery activity, which is learner-centred. Bruner claims that employing this approach in science lectures encourages self-assurance, intellectual excitement, retention, motivation, and critical thinking all of which unavoidably enhance students' performance and retention. Bruner's theory, which highlights that learning occurs when an individual is able to discover a new idea by doing it themselves for increased accomplishment and retention, is relevant to this study.

Despite the benefits of practical exercises from the perspectives of different academics as previously examined. Raymond (2011) states that there are certain drawbacks or restrictions to practical-based training, such as:

1. Long-term preparation with minute details of the entire process is necessary for practical-based instruction because the teacher must ensure that every student has adequate knowledge and abilities about the task they will be performing before engaging the students. Therefore, this strategy cannot be employed on a daily basis due to its lengthy procedure;
2. The method's goals can only be achieved if the lesson is perfectly planned. This approach would be more detrimental than beneficial if there was even the smallest planning error.

Empirical Studies

Several studies that are pertinent to this topic have been reviewed in this section. Machaba & Age, (2024), in an effort to find long-term remedies for students' consistently low maths performance have usually looked at issues like retention. The goal of their study was to use mathematical software to increase senior high school students' memory of geometrical constructs. The study was designed with a non-randomized, quasi-experimental control group of 457 students. Three goals, research questions, and research hypotheses served as the study's compass. The Geometrical Construction Achievement Test and the Geometrical Construction Retention Test were used to gather data. The mean and standard deviation of descriptive statistics were used to examine the gathered data. The study found that the experimental group had better retention (mean = 65.88) than the control group (mean = 51.87). The study found a statistically significant improvement in retention ($p< 0.05$). There were no gender differences when the students were taught using mathematical software.

In Benue State's education zone C, Ogbeba and Adagba (2013) compared the effects of laboratory and discussion approaches on senior secondary students' chemistry achievement. The study was directed by three research questions and three hypotheses. Pre-test-post-test quasi-experimental design was employed in the investigation. The study employed a sample of 196 students from zone B of Benue State, Nigeria, out of a total of 1,924 SS II students. Data was gathered using a validated 30-item Chemistry Achievement Test (CAT). The Kuder-Richardson (KR–21) formula was used to determine reliability coefficients of 0.78 and 0.68. The research issues were addressed using Mean (M) and Standard Deviation (SD) scores, and the hypotheses were tested at the 0.05 level of significance using Analysis of Covariance (ANCOVA). Among other things, the results showed that students who were taught using the laboratory approach outperformed those who were taught using the conventional method ($F (1,195 = 31.90)$, $P<0.05$). Although this study

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seems promising because it focusses on improving the way chemistry is taught and how well students perform in the subject, it hasn't looked for gender variations in achievement and retention.

Martin (2011) studied how integrated science students' performance was affected by an activity-based teaching approach. The study involved 127 Junior Secondary School II students from four classes at the Federal University of Technology Staff Secondary School in Akure, Ondo State's Akure Local Government Area. Each of the four classes received twelve weeks of instruction. Three research topics and three hypotheses guided the investigation. The study used quasi-experimental pre-test and post-test designs. Three classes were given to the activity-based group, while the fourth class was given to the lecture group. A validated 50-item Integrated Science Achievement Test (ISAT) was used to collect data. The research issues were addressed using Mean (M) and Standard Deviation (SD) scores, and the hypotheses were tested at 0.05 levels of significance using Analysis of Covariance (ANCOVA). Among other things, the results showed both male and female students in activity-based groups who were given the opportunity to engage and participate in group activities outperformed those in lecture groups who were passive listeners.

In view of Akuma & Callaghan, (2019) who found that students achieved higher when exposed to practical based activities than their counterparts that were exposed to traditional method in integrated science and elementary science respectively. The likely explanation for this outcome may be connected to the fact that the practical based activities helped the learner to possess a meaningful in-depth knowledge of the content area when compared to the conventional method.

This study's activity-based approach promoted student-teacher, student-student, and student-material interactions. The current study focused on whether practical-based activities would have any impact on students' achievement and retention in genetics, even though the previous study centred on achievement in integrated science.

Gender has piqued the curiosity of several psychologists, scientific educators, and other scholars, leading to an abundance of literature on various aspects of the concept. For instance, numerous studies have examined the relationship between gender and achievement, gender and science and technology, gender and social role, and gender and employment function. In science education, worries about girls' inferior performance are prevalent (Ericson & Ericson, 2010; Welch, 2008; Jegede & Inyang, 2007). They asserted that in the physical sciences, the difference seemed to be more apparent. Fewer girls engage in advanced mathematics and scientific courses and select careers in the sciences, according to Fernema and Shema (2011) in OKoroafo (2014). Boys outperformed girls in school, particularly in the sciences, according to Bajah (2007).

The disparity in gender achievement in science disciplines has been explained by several researchers. According to Allen, Vella-Brodrick, and Waters (2016), other researchers suggest that gender differences in achievement can be explained by a maturational theory, which maintains that men mature more slowly than girls and thus lag behind in literacy and other basic abilities. Joseph, Ramsook, and Simonette (2016) claim that some academics have encouraged the feminisation of curriculum and education, which is harmful to men's academic advancement. Furthermore, some academics propose that curricula be updated to reflect a boy-friendly relevance and pedagogy or a recuperative masculinity agenda (Cobbett and Younger, 2012). Others have noted that the absence of male role models in the school system is one of the primary reasons for male under achievement (Mazjub and Rais 2020).

Sandler (2017) and Kramaerae and Treichir (2014) warned that teachers' reliance on teaching strategies that follow

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conventional norms and beliefs about gender differences that benefit only male students can create a "chilly climate" for girls based on the difference in male-female performances. Additionally, Schwartz and Hanson (2012) note that because women participate less than men, teachers who think that involvement is a sign of learning are inclined to overlook them. Additionally, even among female teachers, the process of classroom engagement is unconscious since they react to students' demands for attention right away. As a result, teachers are often unaware that they are concentrating on teaching guys. The average teacher, whether male or female, is typically drawn to the participating students for attention due to the psychological orientation provided to them. In addition, Giusti, Mammarella, Salza, Vecchio, Ussorio, Casacchia, & Roncone, (2021) opines that there was no statistical difference between boys and girls in the ability to manipulate the apparatus/equipment among others and that gender alone has no effect on academic performance but could act in conjunction with other variables to affect learning outcomes.

Hendrick and Strange (2016) state that even when females do participate in classroom talk, their approach may suggest to teachers that they have less command over the subject matter than males. Girls are more likely to acknowledge the remarks made by earlier speakers, ask questions, and not interrupt ongoing conversations. To put it another way, their behaviour in the classroom is consistent with gender norms that undermine women's assertiveness. This study offers the chance to determine which group males or females—will perform better in biology when instruction is based on practical experience.

Statement of the Problem

Nigeria's academic performance below expectation rates in both public and private schools and institutions have greatly alarmed researchers. Therefore, the use of traditional teaching methods that do not take into account students' participation in teaching and learning processes may be one of the causes of the low performance. After learning about science topics through activities that accommodate various learning styles and intelligences, the researcher has also seen that many students still decide not to participate in class discussions. This might be the result of their disinterest in the conventional chalk-and-talk approach. Some students may even believe that the subjects are challenging.

Additionally, it was shown that large class sizes can impede proper and efficient teaching-learning procedures, which can lead to insufficient instructor supervision and poor student focus. The researcher's experience also demonstrates that because students do not actively participate in class, they tend to recall material for exams and occasionally forget what they were taught when asked about it. Effective teaching and learning processes appear to be hampered by these circumstances, particularly the problem of ineffective teaching methods that prevent students from participating fully in class. The students simply listen to their teachers without paying attention or getting sidetracked by many things, which could lead to poor performance and less assimilation.

Purpose of the Study

This study looked at how secondary biology students in Ekiti State performed and retained genetics knowledge after receiving practical-based instruction.

In particular, the research:

1. Ascertained how students' performance and retention in genetics were affected by practical-based instruction

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2. Determine whether the achievement and retention of male and female students in genetics are different when it comes to practical-based training.

ResearchQuestions

This study was guided by the following research questions:

1. How do students who are taught genetics through practical-based education and those who are taught using the conventional method differ in their mean achievement scores?

2. How do students who learn genetics through practical-based education and those who learn it through conventional method differ in terms of mean retention scores?

3. How do male and female students who get practical-based education in genetics differ in their mean achievement and retention scores?

Hypotheses

At the 0.05 level of significance, the following null hypotheses were examined:

1. Students taught genetics through practical-based education and those taught using the conventional technique did not significantly differ in their mean achievement scores.
2. Students taught genetics using practical-based education and those taught using the conventional method did not significantly differ in their mean retention scores.
3. The mean achievement scores of male and female students who received practical-based training in genetics do not differ significantly.
4. Male and female students who received practical-based training in genetics did not significantly differ in their mean retention scores.

Methodology

A quasi-experimental, non-randomized pre-test, post-test control group design was used in the investigation. As a result, entire classrooms were divided into experimental and control groups at random. The 1356 Biology senior secondary II students from all senior secondary schools in the Ado local government regions of Ekiti State make up the study's target group. The study's sample consisted of 292 Senior Secondary School Two (SSSII) students from Ado LGA in Ekiti state using multistage sampling methodologies. The first stage was to choose government public schools across the local government region. In the second part of the study, six mixed-gender schools from the local government region were selected using a purposive sampling technique. The last step was using complete classes from each of the mixed schools selected for the study.

Data for this study was gathered using a single tool called the Genetics Achievement Test (GAT). GAT is a two-part test created by the researcher. The respondents' biographical information is contained in Section A, and the 25 objective questions in Section B require the respondents to fill in the blanks with the proper response.

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The 25 objective items were constructed so that responders could complete the questions by using the appropriate word or phrase to fill in the blanks. The Biology SS II syllabus serves as the basis for the GAT's material. GAT is used to evaluate students' performance and retention of the material.

The Genetics Achievement Test (GAT) was administered to two seasoned secondary school biology teachers, two lecturers from Bamidele Olumilua University of Education, Science and Technology, Ikere-Ekiti's Science Education Department, and the researcher's supervisor for review in order to assess its face and content validity. The supervisor's authorised version was used after they made the necessary modifications. The split-half method was used to assess the instruments' dependability. Twenty students from two schools that weren't included in the study were given the goods. The same group of pupils was given the test again after two weeks. Split-half procedures, which involve scoring the test's two halves (typically odd and even items) independently, were used to determine the instruments' reliability. The reliability coefficient for the two sets was then calculated using the Spearman-Brown Prediction formula, yielding a final reliability coefficient of 0.73 for the GAT, which is regarded as high for use.

Intact classrooms were assigned to experimental and control groups after which Genetics Achievement Test (GAT) was conducted as pre-test by the researcher with the cooperation of the sampled schools Biology teachers. Before the actual teaching started, this continued for a week. During lessons, the teachers taught the experimentalgroup Genetics themes utilising practical orientated education. The demonstration lesson notes were used to teach the same subjects to the control group. The actual teaching period in each of the studied schools was four weeks.

At the end of these intervals, the pre-test was rescheduled and administered as a post-test. The research assistants employed the marking method developed by the researcher to grade the post-test, which was administered for a week. In order to determine if the knowledge acquired was retained, the researcher allowed an additional four weeks to pass. To gauge the subjects' retention, the post-test was rearranged and given as a retention test. The researcher used the created marking scheme to score the retention exam.

The null hypotheses were checked at 0.05 level of significance using Analysis of Covariance (ANCOVA) for data analyses. The choice of ANCOVA for the test of hypotheses was owing to the fact that it statistically removes the initial differences across the non-randomized groups.

Results

Testing Null Hypotheses

The four null hypotheses formulated for this study were tested using ANCOVA at 0.05 levels of significance. In all cases, the decision rule was that the null hypothesis is rejected if the p value is less than 0.05 and it is not rejected if the p value is more than 0.05.

Hypothesis One

There is no significant difference in the mean achievement scores between students taught using Practical based instruction and those taught using conventional method.

Table 1: ANCOVA Tests for Mean Achievement Scores of Students taught using Practical based instruction and those taught using conventional Method.

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Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1700.332[a]	2	425.083	135.821	.000
Intercept	1792.021	1	1792.021	572.581	.000
Pre-test	297.305	1	297.305	56.184	.000
Method	1634.888	1	1634.888	555.374	.000
Error	901.361	289	3.130		
Total	109366.000	292			
Corrected Total	2601.693	291			

Rsquared =.654 (Adjusted RSquared=.649)

ANCOVA Tests result in Table 1 reveals that there is a significant difference between Practical based instruction and conventional methods of teaching in favour of Practical based instruction F(1,291) =555.374, P(0.0001<0.05). The null hypothesis is therefore rejected. This implies that Practical based instruction method is more effective than conventional method in achievement of students in genetics.

Hypothesis Two

There is no significant difference in the mean retention scores between students taught genetics using Practical based instruction and those taught using conventional method

Table 2: ANCOVA Tests for Mean Retention Scores of Students taught genetics using Practical based instruction and those taught conventional Method

Dependent Variable: Retention-Test

Source	Type III sum of square	df	MeanSquare	F	Sig
Corrected model	3668.557a	2	917.139	304.742	.000
Intercept	1694.134	1	1694.134	562.912	.000
Pre-test	202.482	1	202.482	51.825	.000
Method	3536.532	1	3536.532	117.523	.000
Error	866.754	289	3.010		
Total	**102150.000**	**292**			
CorrectedTotal	**4535.311**	**291**			

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a. R squared=.806(Adjusted RSquared=.803)

ANCOVA Tests result in Table 6 reveals that there is significant difference in the mean retention scores between the students taught genetics using Practical based instruction and those taught with conventional method in favour of Practical based instruction F(1,291)
=117.523, P(0.0001<0.05). The null hypothesis is therefore rejected. This means that Practical based instruction enhanced students' retention in genetics

Hypothesis Three

There is no significant difference in the mean achievement scores between male and female students taught Practical based instruction

Table 3: ANCOVA Tests for Mean Achievement Scores of Male and Female Students taught Practical based instruction

Dependent Variable: Post-Test

Source	Type III sum of square	df	MeanSquare	F	Sig
Corrected model	1014.434a	2	407.217	102.108	.000
Intercept	1336.755	1	1336.755	390.385	.000
Pre-test	211.098	1	211.098	67.876	.000
Gender	14.244	1	14.244	4.160	.064
Error	558.144	143	3.424		
Total	**75044.000**	**146**			
CorrectedTotal	**572.578**	**145**			

b. Rsquared=.025(AdjustedRSquared=.013)

ANCOVA Tests result in Table 2 reveals that there is no significant difference between the mean achievement of male and female students taught Practical based instruction F(1,145) =4.160, P(0.064>0.050). The null hypothesis is therefore not rejected. This means that Practical based instruction enhanced both male and female students' achievement in genetics

Hypothesis Four

There is no significant difference in the mean retention scores between male and female students taught genetics using Practical based instruction

Table 4: ANCOVA Tests for Mean Retention Scores of Male and Female Students taught genetics using Practical based

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Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1011.125[a]	2	5.562	102.007	.000
Intercept	1497.950	1	1497.950	540.606	.000
Pre-test	198.879	1	198.879	66.190	.000
Gender	8.636	1	8.636	3.117	.079
Error	451.652	143	2.771		
Total	75,997.000	146			
Corrected Total	462.777	145			

Dependent Variable: Retention-Test

c. Rsquared=.024(AdjustedRSquared=.012)

ANCOVA Tests result in Table 8 reveals that there is no significant difference between the mean retention scores of male and female students taught genetics using Practical based instruction F(1,145) =3117, P(0.079>0.050). The null hypothesis is therefore not rejected. This means that Practical based instruction enhanced both male and female students' retention in genetics

Discussion

The findings of this study have revealed that students taught genetics using practical based activities achieved higher than their counterparts taught using conventional method. This finding agrees with Akuma & Callaghan, (2019) who found that students achieved higher when exposed to practical based activities than their counterparts that were exposed to traditional method in integrated science and elementary science respectively. The likely explanation for this outcome may be connected to the fact that the practical based activities helped the learner to possess a meaningful in-depth knowledge of the content area when compared to the demonstration method.

It was also found that students exposed to practical based activities have higher retention capacity than their counterpart that was exposed to conventional method. This finding agrees with Machaba & Age, (2024) who found that students have higher retention capacity when they are actively engaged in solving problems through practical based activities than when they become passive learners as obtained in the use of traditional method. The likely explanation for this outcome may also be connected to the fact that the use of practical based activities in science teaching orient students towards reflecting on, interpreting and searching for solutions to the problems themselves when compared to the conventional method.

Another major finding in this study was that male students achieved slightly higher than their female counterparts using hands-on activities but ANCOVA test shows that the difference was no significant. This finding agrees with the findings of Giusti, Mammarella, Salza, Vecchio, Ussorio, Casacchia, & Roncone, (2021) who found that there was no significant statistical difference on the achievement of male and female students in Biology. Based on this finding, achievement in science is therefore not dependent on gender. This means that the age long disparity in science between male and female

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students can be laid to rest with the use of practical based activities.

In addition, the finding of this study also revealed that there is no significant interaction between methods and gender on mean achievement scores and mean retention scores of students in genetics. This shows that practical based activities instructional method is superior to the conventional method irrespective of gender in fostering achievement and retention. This implies that different learners with different characteristics may profit more from one type of instructional method than from another and that therefore it may be possible to find the best match of learners' characteristic and instructional method in other to maximize learning outcomes. In this case, there is no need for separation of instructional method for male and female since practical based activities method could be used successfully for the two groups.

Conclusion

The use of practical based instruction enhanced students' achievement in genetics. It also enhanced students' retention than the use of conventional method. No gender disparity exists in the achievement and retention capacity of male and female Biology student taught genetics using practical based instruction. This implies that practical based instruction method is very rewarding to students' in-terms of achievement and retention capacity regardless of gender. This implies that there is no need for separation of instructional method for male and female since practical based instruction could be used successfully for the two groups.

Recommendations

Based on the findings and conclusion of this study, the following recommendations were made:

1. Since practical based instruction teaching method is found to be an effective method for improving students' achievement and retention, the Biology teacher should accept it in teaching in our secondary schools.
2. Teacher's trainee should be trained on the application of hands-on activities and serving teachers should employ the use of practical based in teaching to enhance students' achievement and retention in genetics.
3. Practical based instruction teaching/learning method is not gender sensitive therefore both male and female students should be involved in hands-on activities to enhance their achievement and retention in genetics.
4. Practical based instructions require that, there should be standard laboratory and sufficient instructional materials. Schools should provide good laboratory, sufficient instructional materials for students to carry out necessary activities in genetics through hands-on activities.
5. Workshops, conferences and seminars should be organized by Ministry of Education and other school administrators on the need for hands-on activities in the teaching of genetics in order to enhance students' achievement and retention.

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